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MINISTRY OF WATER RESOURCES

No. 22

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

FEASIBILITY REPORT
BICHENA

(Volume II-X)

FEBRUARY, 1996

SANYU CONSULTANTS INC.
KYOWA ENGINEERING CONSULTANTS CO., LTD.

GOVERNMENT OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY(JICA)
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PREFACE

This is the Feasibility Study Report for Bichena 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.

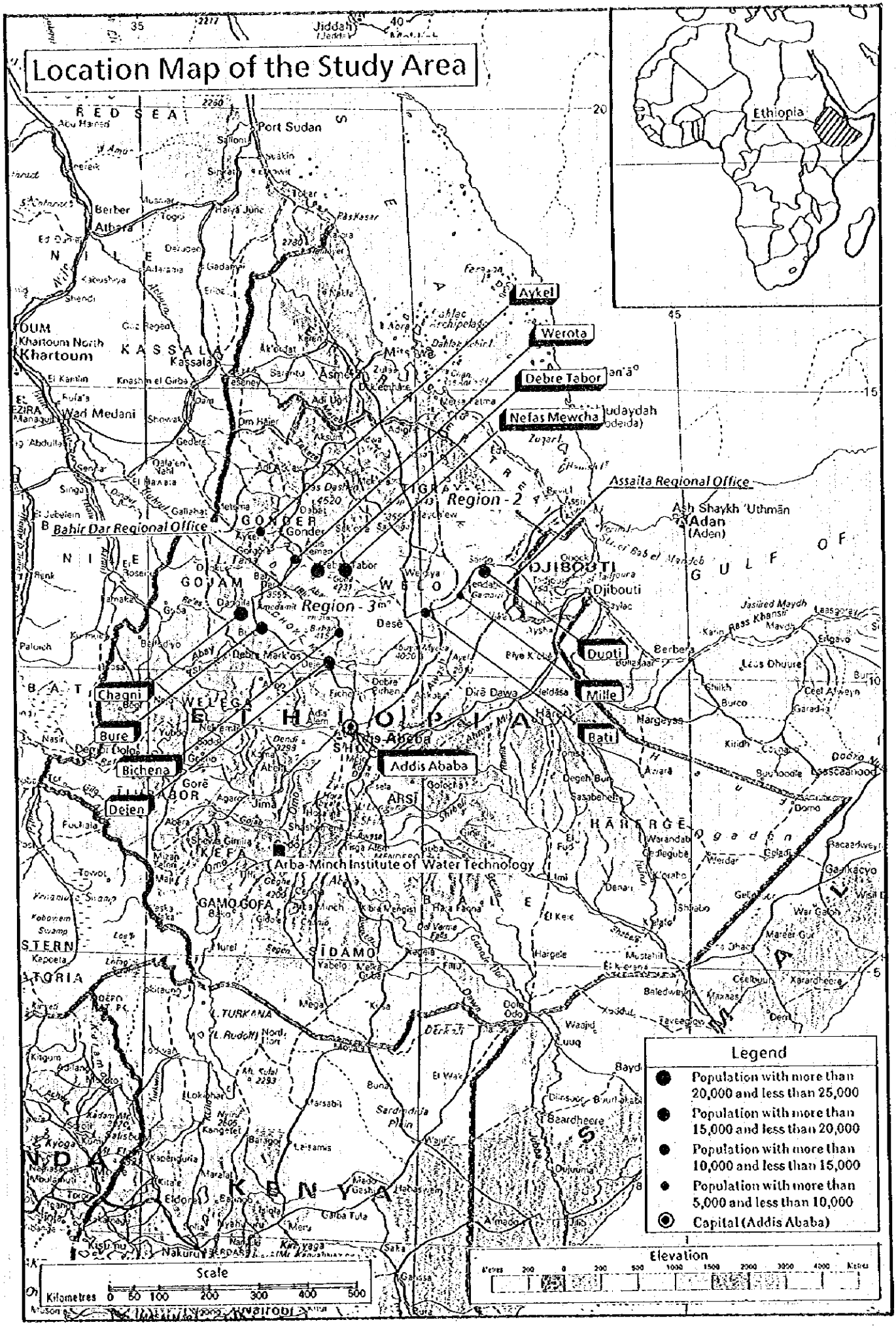
The major objectives of this Study are 1) to conduct a feasibility study on the water supply system in order to improve living condition of the population in the Study area by enhancing the level of the water supply services in terms of water quantity, water quality and its accessibility, 2) to formulate 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.

With the survey and the study, this report presents the formulation of the Project of the water supply system with the implementation program, improvement plan of sanitary facilities with the diffusion program, set-up and strengthening of organization, and strengthening of operation and management.

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.


Location Map of the Study Area
Ethiopia
Aykel
Werota
Debre Tabor
Nefas Mewcha
Assaita Regional Office
Bahir Dar Regional Office
Region - 2
Region - 3
Addis Ababa
Arba-Minch Institute of Water Technology
Dire Dawa
Djibouti
Legend
Population with more than 20,000 and less than 25,000
Population with more than 15,000 and less than 20,000
Population with more than 10,000 and less than 15,000
Population with more than 5,000 and less than 10,000
Capital (Addis Ababa)
Scale
Kilometres 0 50 100 200 300 400 500
Elevation

General Description of Current Condition in Bichena

Items	Description
Administration	Amhara Region, East Gojjam, No. of Kebele : 2
Residents	Total population : 14,629 (2.3 persons/ha) Average family size : 6.2 persons Amhara : 99% Christians : 67% (2 churches) Oromo : 1% Moslems : 33% (2 mosques) : %
Educational Conditions	

	Kinder garden	Elementary school	Junior high s.	Senior high s.
No. of school	2	2	1	1
No. of teachers	4	104	27	30
No. of students	132	1850	618	865

Medical Conditions	Hospital : - Doctor : 2 Health center : 1 Nurse : 4 Health clinic : -
Economic Conditions	Hotels/restaurants : 47 Shops : 337 Cottage industry : 27 Others : 3 Average monthly household income : 324 birr
Water Supply Condition	The source of WSS : Borehole (2) Major other sources : Hand dug well & Spring Domestic consumption : 79.4 cum/day (8.1 lpcd) Other consumption : 11.8 cum/day (total 91.2) Water service coverage : 67% House connection : 26.4 lpcd (1%, 1.25 birr/cum) Yard connection : 22.0 lpcd (10%, 1.25 birr/cum) Neighbors : 7.9 lpcd (11%, 1.25(3.6) birr/cum) Public fountain : 4.7 lpcd (45%, 1.25(2.2) birr/cum)
Sanitary Condition	Septic toilet : -/100HH Dry pit toilet : 43/100HH Community toilet : 1/100HH Open field : 56/100HH Toilet condition : Ill-maintained and constructed. Sullage disposal site : No allocated and vacuum track is required. Drainage facilities : No existed except along main road, poorly maintained.
People's Health Awareness and Needs	Group awareness : 25% Diarrhea awareness : 40% ORS awareness : 10% Sanitary behaviors score : 807/1600 (50%) Needs : Adequate Water, Health Education, Electricity
Remarks	1. Water charge in bracket is actually paid. 2. HH means "household". 3. ORS means Oral Rehydration Solution. 4. Faecal coliforms found in samples from connections and household containers.

Project Description of Bichena

Items	Description
Project Title	Eleven Centers Water Supply and Sanitation
Executing Agency	Water Supply and Sewerage Service Department(WSSD)
Objectives	To supply domestic water which meets people's demand and to improve sanitary condition in the center.
Population Projected	in 1995 2000 2005 2010 14,629 (5.5%) 19,120 (5.0%) 24,403 (4.5%) 30,411
Water Demand Projected in cum/day	in 1995* 2000 2005 2010 Domestic : 79 330 610 1,127 Non Domestic : 12 48 65 86 Losses : 10 42 92 214 Total : 101 420 767 1,427
Dimensions of Water Supply System	Target Service Coverage: 85%(67% at present) Target Year of 2005 Deep Wells : 2 (190m) Rising Main : ϕ150(2.70km),ϕ100(4.07km), ϕ75(0.72km) Booster of Rising : ϕ100mm,Q=0.32m^3/min,H=70m ϕ100mm,Q=0.32m^3/min,H=70m Reservoir : 160m^3(80×2) Distribution : ϕ200(320m),ϕ150(3,825m), ϕ75(5,105m),ϕ50(13,050m) Booster of Dist'n : ϕ200mm,Q=1.1m^3/min,H=13m Target Year of 2010 Deep Wells : 2 (192m) Rising Main : ϕ150(0.92km),ϕ100(0.92km)
Water Tariff Structure & Accounting System	Introduction of Progressive Water Tariff** HC: 3.43 birr/m^3,YC: 2.31 birr/m^3,PF: 1.48 birr/m^3 Introduction of Double Accounting System
Plan of Sanitary Facilities Improvement	Construction of 3 public toilets and facilitation of other type toilets. Provision of toilet emptying system. Maintenance of main drainage and construction of supplemental drainages. Facilitation of waste water disposal pit and dry solid waste disposal system.
Plan of Sanitary Education and Implementation Program	Utilization of sanitary education manual and video. Application of sanitary education priorities(see report). Set-up of Sanitary/Health Committee. Assignment of Community Participation Promoter.
Organization Set-up	Strengthening of Planning & Project Department of MWR and relationship among central, regional and town. WSS to be composed of Administration, Financial, Technical and Sanitary Service, and manpower to be 31 in 2005 and 43 in 2010.
Remarks	* Actual Consumption ** Water Tariff for industry and institution is same as HCs'.

Composition of the Report

Report
- Executive Summary
- Main Report (Volume I)
- Feasibility Report (Volume II-I to II-XI)
- Appendixes (Volume III-I to III-XI)

Others
- Operation and Maintenance Manual
- Sanitary Education Manual
- Sanitary Education Video (titled Simple Steps... for Better Health)

Table of Contents

ABBREVIATIONS

[ORGANIZATION]

AfDB or ADB	- African Development Bank
AfDF or ADF	- African Development Fund
AWTI	- Arba-Minch Water Technology Institute
CIDA	- Canadian International Development Agency
CPPS	- Community Participation Promotion Services
CSA	- Central Statistical Authority
EELPA	- Ethiopian Electric Light and Power Authority
EIGS	- Ethiopian Institute for Geological Survey
EMA	- Ethiopian Mapping Authority
EPD	- Environmental Protection Department
GOE or TGE	- Transitional Government of Ethiopia
GOJ	- Government of Japan
IBRD	- International Bank for Reconstruction Development (The World Bank)
JICA	- Japan International Cooperation Agency
KFW	- Kreditanstalt fur Wiederaufbau
MEDP	- Ministry of Economic Development Planning
MEEC	- Ministry of External Economic Cooperation
MNRDEP	- Ministry of Natural Resources Development and Environmental Protection
MOA	- Ministry of Agriculture
MOH	- Ministry of Health
MPI	- Master Plan Institute
MPWUDH	- Ministry of Public Works and Urban Development and Housing
MWR	- Ministry of Water Resources
NMA	- National Meteorological Authority
NMSA	- National Meteorological Service Agency
NGO	- Non-Governmental Organization
NRDPEPB	- Natural Resources Development & Environmental Protection Bureau
PWUDB	- Public Works and Urban Development Bureau
REA	- Regional Education Authority
REWA	- Revolutional Ethiopian Women Association
RRC	- Relief and Rehabilitation Commission
UN	- United Nations
UNDP	- United Nations Development Program
UNICEF	- United Nations Children's Fund
TADE	- Tendaho Agricultural Development Enterprise
WAB	- Women's Affairs Bureau
WHO	- World Health Organization
WRDA	- Water Resources Development Authority
WSS	- Water Supply Service
WSSA	- Water Supply and Sewerage Agency
WSSD	- Water Supply and Sewerage Service Department (former WSSA)
WWCE	- Water Works Construction Enterprise
WWDE	- Water Well Drilling Enterprise

[OTHERS]

BOP	- Balance of Payment
CPP	- Community Participation Promoters
DCI	- Ductile Cast Iron
Dia	- Diameter
DWL	- Dynamic Water Level
EB	- Ethiopian Birr (Birr or birr)
E.C.	- Ethiopian Calender
ERRP	- Ethiopian Relief and Rehabilitation Programme
EIA	- Environmental Impact Assessment
EIRR	- Economic Internal Rate of Return
FIRR	- Financial Internal Rate of Return
FRP	- Fiberglass Reinforced Plastic
GDP	- Gross Domestic Product
GNP	- Gross National Product
GS	- Galvanized Steel
HC	- Household Connection
IEE	- Initial Environmental Examination
lpcd	- liters per capita per day
l/s	- liters per second
m.asl	- meters above mean sea level
mg/l	- milligram per liter
ND or DN	- nominal diameter
NP or PN	- nominal pressure
O & M	- Operation and Maintenance
pa	- per annum
PC	- Private Connection
PF or P.F.	- Public Fountain
pm	- per month
PCM	- Project Cycle Management
PDM	- Project Design Matrix
PVC	- polyvinyl chloride
SWL	- Static Water Level
TB	- Tuberculosis
TOR	- Terms of Reference
USD	- United States Dollar
VES	- Vertical Electric Sounding
WID	- Women in Development
YC	- Yard Connection

Exchange Rate

1 US Dollar = 6.3 Birr

1 US Dollar = 94.5 Yen

1 Birr = 15.0 Yen

GLOSSARY

Belg	- Short & moderate rain in spring, autumn or winter
Birr, Br	- Ethiopian currency unit
Debo	- Small association in rural area to work collectively in farm
Eder	- Community organization for social occasions & social problems
Kebele	- Smallest unit of administration
Keremt	- long & heavy rain in summer
Kilil	- Region (a group of zones)
Shet	- Stream
Wenz	- River
Woreda	- An administrative sub-district (also referred to as Wereda)
Zone	- A group of Weredas

Note: There is, as yet, no standardized spelling of Ethiopian words written in Roman Letters and based on English phonetics. Consequently, different spellings of the same word may be encountered in the report, particularly on the EMA maps.

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Chapter 1 Introduction

1.1 Background

Most of the Ethiopian population do not have adequate and safe access to potable water supplies or sanitation facilities, leaving people vulnerable to water-borne and sanitation-related infectious diseases.

In 1994, only 26 % of the total population and 18 % of the rural population were estimated to have access to potable water. Consequently, the majority of the population is exposed to polluted water and thus to water-borne diseases. It is also estimated that less than 12 % of the total population uses latrines. An estimated 1 % only of the rural population have access to adequate refuse disposal systems.

Surveys of morbidity patterns and levels have pointed the consequence to the effects of poor water supply and hygiene practice, and unsanitary excreta disposal. Addressing health problems through water supply and sanitation activities is evident.

In Bichena, water service coverage is 67 %, and the water consumption per capita per day is extremely low with the amount of 8.1 lpcd in average. Although water quality of the sources is acceptable with reference to WHO drinking water guideline in terms of physico-chemical aspects, many faecal coliforms have been detected in samples collected from connections and household containers. This suggests that contamination is expected in such way through cross-connection, leaking and back-siphoning associated with aged facilities.

Toilet coverage is 44 % only, and those toilets are mostly ill-maintained and poorly designed/constructed in terms of ventilation and emptying, thus the majority of the population dispose off their body waste in open field. Also, sullage disposal sites are not prepared, making difficult to dispose of emptied ones. Drainage facilities are not well constructed except ones along main road, constructed by road authority. And, even the drainage along main road is not well maintained, accompanying blockade by garbage or refuse disposal.

In view of the above situation, the Government of Ethiopia (GOE) put priority on the Eleven Centers Water Supply and Sanitation among 230 rural centers listed in the National Development Plan (ERRP 1993-95). Bichena is the one, located in Amhara Region, among the Eleven Centers along with Dupti, Mille, Bati, Nefas Mewcha, Aykel, Werota, Debre Tabor, Chagni, Bure and Dejen as shown on the attached Location Map.

1.2 Overall Progress of the Study

The Team arrived in Ethiopia on January 5, 1995 and submitted the Inception Report to Water Supply and Sewerage Service Department (WSSD). Both parties had discussed and confirmed the plan of approach, plan of operation, schedule of the Study, undertakings of the both parties and other related matters. Following the confirmation, the Team immediately commenced the Phase I survey/study.

The Team had collected and reviewed the existing data and information related to the Study. After reviewing the data and information gathered, reconnaissance survey covering all Eleven Centers had been carried out throughout the month of January by the Team members and their counterparts. The survey was conducted to recognize the overall situation of the centers, give common understandings among the members, and identify the centers to be studied in Phase I and Phase II respectively. Bichena was selected for the detailed survey during Phase II. The survey items and major activities are described below:

Meteorological and hydrological survey had been conducted through the aerial photographs, topographical maps, related rainfall/river discharge data collected, and further field observation in order to understand the drainage and recharge systems of the Study area.

For the geological part, geo-electric prospecting (GEP) survey had been conducted to identify the hydrogeological condition to be required for designing water supply systems. The 17 points at each center had been prospected with a maximum depth of 150 meters.

Water quality of the existing water sources and surface water had been examined in terms of physico-chemical characteristics. The analysis items and procedure were made in accordance with WHO drinking water quality guidelines. Also water samples had been undertaken for bacteriological tests, which were collected from the water sources, public fountains, private connections and household containers in order to identify the place of contamination.

Topographic survey had been made along the existing water supply transmission lines and distribution lines through the reservoirs. Also, proposed water supply distribution lines, which start at prospective water source(s) identified by GEP, had been surveyed.

Survey on water use condition had been conducted by filling-out questionnaire form(s) at 100 households as well as schools, institutions, industries, hotels and restaurants in each center. A census for water consumption had also been carried out in all areas being supplied with piped water. These surveys have clarified the water supply quantity and service rate as well as people's demand for water both in quantitative and qualitative aspects.

Survey of sanitary and health condition had been also carried out together with the above water use condition survey. Interviews had been conducted at the above 100 households, and sanitary facilities such as the type of toilet, condition of facility and utilization, treatment of dejecta/excretion and situation of solid wastes disposal had been observed.

Survey of social background aims at minimizing the possible negative effects which may be expected on the society and the people. The survey had been carried out by the same 100-household-interviews, questioning key informants such as Wereda, Kebele, school teachers, health workers and other community leaders, and meetings with various focused groups.

Socio-economic survey had been conducted with 100-household-interviews as well as questioning key organizations and institutions. This survey clarifies household level economy and financial condition of those organizations/institutions, contributing to introduction of affordable water tariff system and sound account of WSS.

Initial environmental examination (IEE) had been carried out on all Eleven Centers during reconnaissance and Phase I surveys. As a result of IEE conducted in Phase I, detailed environmental survey had been carried out during Phase II survey in accordance with the terms of reference made on IEE. Based on the result of IEE and the detailed environmental survey, environmental impact assessment (EIA) for each center had been made in parallel with the project formulation.

Besides the surveys mentioned above, a sanitary education video titled "Simple Steps.....for Better Health" was firstly produced in this water & health sector of Ethiopia with different languages as Amharic, Afar and English.

With the completion of those surveys mentioned above, comprehensive evaluation and understanding of problems had been made based on the present situation. Then, concept and basic strategy of the Project had been formulated at the end of field survey in Phase II, and presented in the Interim Report.

After returning to Japan, the Team started Home Work in Japan to finalize the project formulation based on the concept mentioned in the Interim Report and agreed by WSSD through discussions. Those outcomes are presented in this report together with operation and maintenance manual and sanitary education manual.

Chapter 2 Natural Condition

2.1 Meteorology and Hydrology

Bichena is located in the east Gojam on the Mota-Dejen road. The major rivers around the town are Suha river, Banja river and Kuy river which drain to the Abay. Suha river has a large watershed area of 359 km^2 at the gauging station located on the road to Dejen. Banja river is originated from the town. The land has a moderate undulation except for the long cliff in the west of the town along the watershed of Suha river.

Bichena has a Meteorological station of NMSA and a river gauging station of WRDA on Suha river. See Figure 2.1.1 for the locations and the watersheds around the town.

Table 2.1.1 shows the long term monthly mean values of precipitation, potential evapotranspiration and air temperature obtained from NMSA.

Table 2.1.1 Long Term Monthly Mean Values of Precipitation, Potential Evapotranspiration and Air Temperature

Elements	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
P(mm)	7.2	35.2	48.6	36.2	72.4	120.8	256.9	130.3	43.2	20.1	9.5	4.5	784.7
ETo(mm)*	117	116	116	116	115	114	112	111	112	113	115	116	1,373
A.Temp.(°C)	17.2	17.1	17.5	17.8	19.4	17.4	15.6	15.7	-	16.7	16.3	16.5	17.0

Remark: * = Data of Debre Markos
- = not calculated due to missing data

The monthly precipitation shows two weakly pronounced rainy season in March and one strongly pronounced rainy season in July. It ranges from 4.5 mm in December to 256.9 mm in July. Since the record of potential evapotranspiration is not available, the data of Debre Markos is listed in the table. The monthly potential evapotranspiration does not vary much throughout year ranging from 11 mm in August to 117 mm in January. The monthly air temperature does not vary much either ranging from 15.6°C in July to 19.4°C in May. The low potential evapotranspiration and the low air temperature in July and August are caused by the heavy rainy season "Keremt".

The existing wells are located along Banja river and the proposed sites for new wells are mostly located along the major linearment in the watershed area of Suha river.

In order to assess the ground water recharge in the areas, the water balance sheet for Suha river is prepared as shown in Table 2.1.1 assuming the potential evapotranspiration to be same as the long term one and the reference crop evapotranspiration to be 70% of the potential evapotranspiration. The precipitation data of Dejen is provided in spite of the data of Bichena because the data of Bichena is short and does not coincide with the runoff data in time. The precipitation data of Dejen and the runoff data have the six (6) year records between 1985 and 1990.

Table 2.1.2 Water Balance Sheet of the Ground Water Recharge, Suha River at Bichena

Unit : mm

Elements	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
P	4.9	25.8	82.8	80.0	61.1	101.7	296.7	335.4	193.4	68.2	0.1	11.8	1,262.3
Q	1.3	1.3	0.5	2.1	3.3	4.7	42.7	102.2	36.5	11.2	2.4	4.8	213.0
P-Q	3.6	24.5	82.3	76.7	57.8	97.0	254.7	233.2	157.3	57.0	*	7.0	—
ETo	117	116	116	116	115	114	112	111	112	113	115	116	1,373
ETcrop	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	3.6	24.5	81.2	76.7	57.8	79.8	78.4	77.7	78.4	57.0	—	7.0	—
ΔS	0	0	1.1	0	0	17.2	176.3	155.5	78.9	0	—	0	429.0

Note: P = Precipitation
Q = Runoff
ETo = Potential Evapotranspiration
ETcrop = Reference Crop Evapotranspiration
ETa = Actual Evapotranspiration
ΔS = Recharge
* = Distorted Data
— = not calculated due to distorted data

According to this sheet, the recharge takes place from June to September. The annual recharge in an average year is found to be 429.0 mm neglecting the little distortion in November. This large recharge is probably caused by the thick previous soil layers in the watershed area. The quantity of recharge is calculated with this value for the watershed area of Suha river:

$$0.429 \times 359 \times 10^6 = 154.0 \times 10^6 \text{ m}^3/\text{year}$$

This is equivalent to 421.9×10^3 m^3/day.

The proposed site for new well in the watershed area of Banja is VES St. 6. Since the watershed area is relatively small i.e. 5.13 km^2 and there is an existing well upstream, it must be checked if there is a sufficient recharge for the wells.

Yearly water balance sheets were prepared for the six (6) years between 1985 and 1990 as shown in Appendices. The recharge of each year is shown below in Table 2.1.3.

Table 2.1.3 Monthly Recharge Estimated by Means of Surface Water Balance Analysis Suha River at Bichena

Unit : mm

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1985	—	—	0	37.3	34.5	0	128.3	151.6	61.2	0	—	0	412.9
1986	—	0	0	42.3	0	71.7	165.8	0	113.5	0	—	—	393.3
1987	—	0	40.7	0	24.9	0	153.2	149.4	6.4	0	—	0	374.6
1988	0	0	—	0	0	125.	294.3	220.2	64.5	7.5	—	—	599.0
1989	—	0	74.2	28.2	0	21.0	85.3	264.5	103.4	0	—	0	576.3
1990	—	0	27.1	0	0	43.8	226.7	170.1	124.2	0	—	—	591.9

Note: — = not calculated due to missing data

Applying the probability analysis for the annual recharge using log-normal two parameter distribution function, 5-year recharge and 10-year recharge of dry years are resulted at 398.7 mm and 361.3 mm respectively.

It is is allowed to apply these values for the watershed area of Banja river at VES St. No. 6, the quantity of recharge is estimated:

5-year recharge $0.3987 \times 9.3 \times 10^6 = 2.05 \times 10^6$ m^3/year
10-year recharge $0.3613 \times 9.3 \times 10^6 = 1.85 \times 10^6$ m^3/year

These are equivalent to 5,600 m^3/day and 5,070 m^3/day respectively.

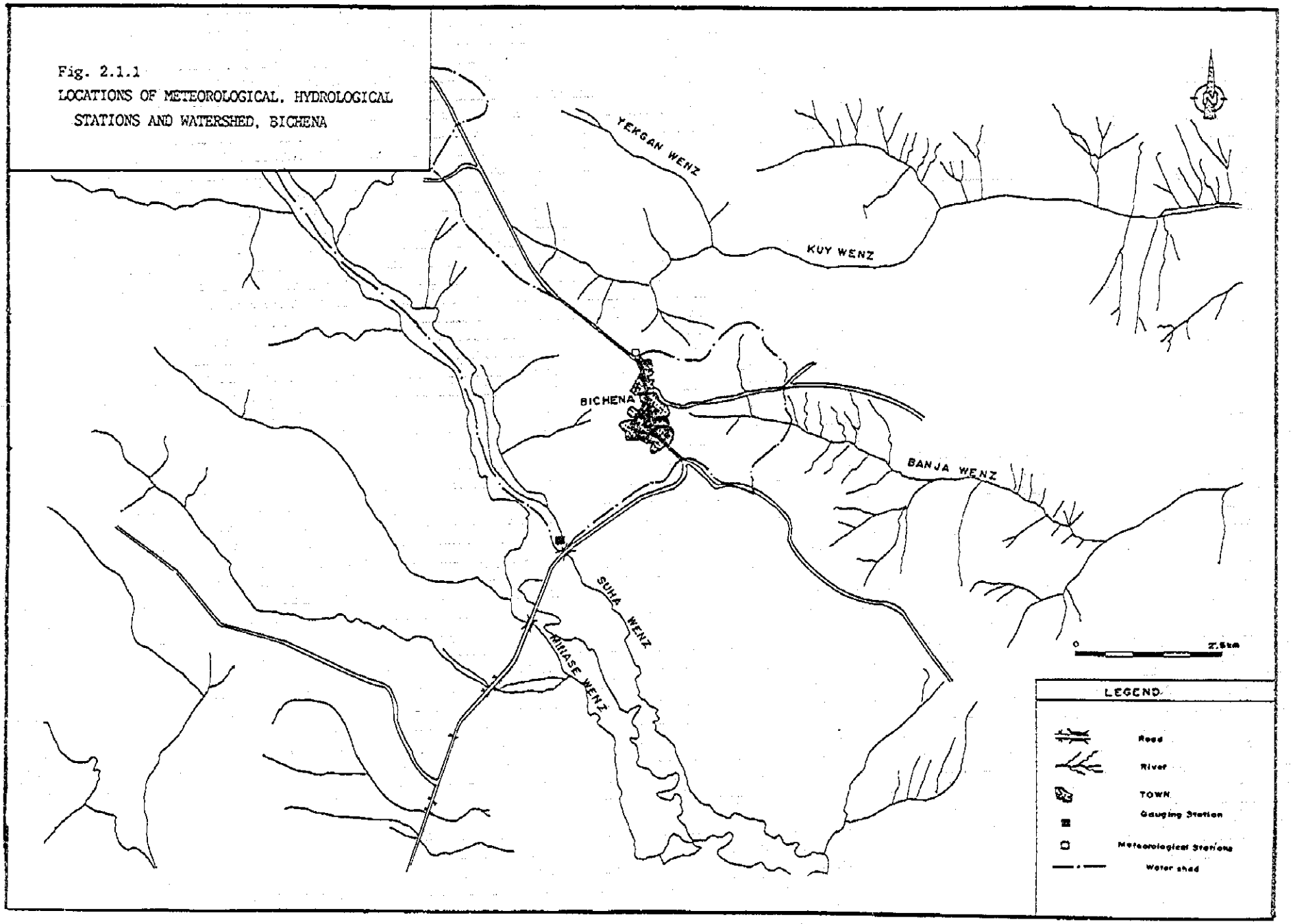


Fig. 2.1.1
LOCATIONS OF METEOROLOGICAL, HYDROLOGICAL STATIONS AND WATERSHED, BICHENA

2.2 Hydrogeology

2.2.1 Geology

Bichena town is located on a gently sloping plateau with a direction of NW-SE. The Suha and the Minase River which flow through in a wide plain extending to the NW-SE direction are situated at 2 km west of the town. The deep wide valley with overhanging cliff walls which is cut by Kuy River flowing out into the Abay Gorge extends eastward from the 4 km northeast of the town. The plateau, of which altitude is about 2500 m.asl, is dominated by alkali-olivine basalt belonging to the Ashangi group of Paleocene - Miocene. The basalt is weathered at the surface portion and along the jointed cracks.

Alluvial deposit consisting of dark brown clay and silt covers basalt in the Suha and Minase River plain.

This lower plain is in fault contact with the plateau at the west end of the town. The fault is clearly present as a major lineament at the west of the town where steep escarpment extends northwestward from the south end of the town.

2.2.2 Hydrogeology

(1) Groundwater

Generally, ground water potential in the area dominated by volcanic rocks is discouraging unless the rocks are fractured by faulting and weathering. The hydrogeological condition of the Bichena area depends on the inherent property of the volcanic rock (for example, vesicles in lava), secondary porosity produced by fracturing and the interconnection between each pore space of the rock. From the geomorphological point of view, four sites are expected to obtain ground water, that is, the Suha and Minase River plain, the Bala Wedeb basin, the Yekegan and Kuy basin and the 5 km east-northeast area from the town (the north side of the Bichena - Yeduha road). In the Suha and Minase river plain, two boreholes were drilled in the past but both boreholes were abandoned due to insufficient yield. These boreholes were not drilled on the fault line mentioned above. The foot of the escarpment of west side of the town is nominated as the target area. In the Bara Wedeb basin, two boreholes were drilled and they are productive now. Borehole No.1 which was drilled in 1974 is located at 1 km east of the town. No borehole data for the total depth, the screen position, the safety yield, pump position, lithological log and so on are available. From the verbal information, the yield is deteriorated and the safe yield is less than 2 l/s at present. Borehole No.2 was drilled in 1992 at 5 km east-southeast of the town. It has a safe yield of 5 l/s and its depth is 56 m. Water bearing formations are fractured basalt and the weathered portion of the basalt surface. In the Kuy and Yekegan basin, one borehole was drilled at the upstream of the Kuy River but it was dry. In this basin, the down stream site of the junction between the Kuy and Yekegan River might be a target area.

(2) Other Water Source

Even the river water of the Suha and the Minase River is negligible in the dry season. Only the Muga River is a perennial river in this area, which is a tributary of the Abay River and situated about 18 km south of the town.

Chapter 3 Present Social, Water Supply and Sanitation Condition

3.1 Result of Water Quality Analysis

Water quality analysis has been made in both physico-chemical and bacteriological aspects, using calorimetric, volumetric analysis and filtration technique methods respectively. In the operational procedure and application of guideline value, "WHO Guidelines for Drinking-Water Quality 1993" has been referred to. The results are shown in Appendix-2 "Result of Water Quality Test" of Appendixes (Volume III).

3.1.1 Physico-chemical aspects

Three (3) samples had been undertaken for the physico-chemical test, among which two (2) samples were collected from the Borehole No.1 on different date, and one (1) from a hand-dug-well. The WSS sources in Bichena are Borehole No.1 and No.2, the latter of which was not functioning during the site survey as of July, 1995. Also, many private hand-dug-wells with a depth of 25 to 30 m are served as supplementary water source.

The chemical constituents, which were analyzed for the Borehole No.1, are found within the acceptable range according to WHO drinking water guideline values. The sample from the hand-dug-well also fit for drinking purpose based on the guideline, though the sample is categorized into moderately hard water.

3.1.2 Bacteriological Aspects

Thirty two (32) samples in total had been tested for faecal coliform, those of which were from the fountains, connections, hand-dug-wells and household containers. Although the source of Borehole No.1 could not be accessed because of rainy season, the results of fountains and connections shows that the water is contaminated with several number of faecal coliforms except one sample collected from the yard connection installed in the health center. With such contaminated water stored, household containers show more contamination with coliforms. Thus, it is recommended to introduce occasional disinfection of the sources, distribution lines, and reservoir in order to ensure safe supply of drinking water.

For hand-dug-well, six (6) samples from different wells had been tested in terms of faecal coliform. Most of wells seemed relatively well protected free from sewerage and cattle, however almost were found to be badly contaminated with too-many-to-count faecal coliforms.

3.2 Current Water Consumption and Demand

3.2.1 General

The data of the production and the billed consumption for past 2 years were given by the staff and summarized in Table 3.2.1. According to the consumption data, the monthly

consumption rate decreases in rainy season. Total consumption and production for past two years are given below.

Production	45,429 m^3
Consumption	40,455 m^3
Losses	about 10 %

3.2.2 Water Users

According to the water consumption census conducted by the Team, the total population served by the water supply is about 9,800, which is accounted for 67% of the total population of 1995. Domestic, institutional commercial and industrial consumptions are calculated from the consumption records of May, 1995 and the census data. Domestic consumption is subdivided into house connection, yard connection, public fountains and those who buy and borrow water from neighbors (vendors), considering mode of services. Table 3.2.2 shows the results of the data processing.

Table 3.2.2 Water Consumption and Demand

Categories	No. of Customers	Population served		Day Consumption		Day Demand	
		Population	(%)	(m^3)	(LPCD)	(m^3)	(LPCD)
Domestic	2235	9768	(100)	79.4	(8.1)	181.1	(18.5)
House Connection	18	146	(1.5)	3.8	(26.4)	3.9	(26.7)
Yard Connection	211	1454	(14.9)	32.1	(22.0)	32.1	(22.0)
Public Fountain	1497	6607	(67.6)	31.2	(4.7)	115.6	(17.5)
Neighbors	509	1561	(16.0)	12.3	(7.9)	29.5	(18.9)
Institutional	19			5.4			
Commercial	395			4.1			
Industrial	4			2.3			
Total	2652			91.2			

There are 19 customers with house connection. All of them except for the health center and the commercial bank are private. Many of them are engaged in businesses. Large consumers are two (2) hotels (lodgings), two (2) public showers and the health center. The domestic lpcd is calculated at 26.4 from the census data. The domestic consumption of house connection customers is calculated at 3.8 m^3/day from this lpcd figure and the population served accounted at 146. Their commercial consumption is calculated at 0.8 m^3/day, excluding their domestic consumption. The institutional consumption is 0.55 m^3/day, which is also the consumption of the health center. The commercial bank did not consume any in May, 1955. There is no industrial customer with house connection.

There are 222 customers with yard connections. Most of them are private customers and many use water for their businesses as well as domestic purposes. The domestic lpcd is calculated at 22.0 from the census data. From this lpcd figure and the population served accounted at 1,454, the domestic consumption of yard connection customers is calculated at 32.0 m^3/day. There are 11 institutional customers and their consumption is 4.6 m^3/day. Almost half is consumed by the prison and it has domestic character. There are 55 commercial customers whose businesses are hotels, coffee bars, eateries, breweries (Tala, Tej houses), shops, etc. Their commercial consumption is calculated at 3.3 m^3/day,

excluding their domestic consumption calculated at a rate of 22.0 lpcd. There is one customer who uses water for building his grain mill. His consumption is 2.3 m^3/day and sorted as industrial.

Majority of the water users are public fountain users, accounting for 68% of the total population served. There are 257 households engaged in small businesses such as breweries (Tej, Tela houses), tea rooms, shops, etc.. Since the lpcd of PF users is as little as 4.7, it is considered that their consumption for businesses is negligible. There are also three (3) institutions, two (2) industrial users and an agricultural user (cattle breeder). However, their consumption is minimal and therefore is not accounted for.

Those who borrow and buy water from the neighbours (vendors), are accounted at 509 households and three (3) institutions. Their domestic lpcd is obtained at 7.9 from the census data. The domestic consumption of those who buy and borrow water are calculated at 12.3 m^3/day from the lpcd and the population served accounted at 1,561. There are 71 households engaged in small businesses. Their consumption for businesses is very minimal. The consumption of the institutions is also very minimal.

3.2.3 Current Water Demand

The water required by the users of different mode of services for different domestic purposes was surveyed. In the survey, five (5) major categories of the users are adopted including Traditional Source Users (TSU). Six (6) sample households of each category are selected from those which do not give or sell water to neighbours and do not engage any businesses either.

In area wise, the western area of Kebele 01 is selected because the area is relatively sufficient in water supply. For the samples of Traditional Source Users (TSU), Gedam Safer area is selected, where there are hand-dug wells.

The survey result ranges from 10.5 lpcd of TSU to 24.2 lpcd of house connection users. In order to calculate the domestic day demand, the lpcd of current consumption is applied for house connection and yard users and those who buy and borrow water from neighbours.

Table 3.2.1 Water Production and Consumption in Bichena

Consumption (m3)

	IC	PF1	PF2	PF3	PF4	PF5	PF6	PF7	Sub Total	Grand Total
Jul-93	529	63		84	80	77	55		359	888
Aug-93	687	68		146	142	98	100		554	1,241
Sep-93	1,109	134		174	145	106	113		672	1,781
Oct-93	1,136	89		113	121	104	92		519	1,655
Nov-93	793	33		40	56	33	30		192	985
Dec-93	606	18		22	10	12	21		83	689
Jan-94	1,052	15		11		10	16		52	1,104
Feb-94	1,105	36		28	88	50	22		224	1,329
Mar-94	1,096	29		32	57	20	16		154	1,250
Apr-94	1,229	25		36	69	28	21		179	1,408
May-94	1,188	40		90	30	84	21		265	1,453
Jun-94	1,233			105		183			288	1,521
Jul-94	1,066			90		161			251	1,317
Aug-94	1,112	1		160		196	11		368	1,480
Sep-94	1,257	42		87		131	71		331	1,588
Oct-94	1,578	43		79	70	96	73		361	1,939
Nov-94	1,410	81		100	65	88	80		414	1,824
Dec-94	1,837	234		173	269	209	265		1,150	2,987
Jan-95	1,609	225		97	270	208	247		1,047	2,656
Feb-95	1,733	250	62	101	272	201	257	98	1,241	2,974
Mar-95	1,934	265	41	168	238	165	269	50	1,196	3,130
Apr-95	1,811	172	57	68	107	150	159	20	733	2,544
May-95	1,745	160	84	85	203	149	254	32	967	2,712
Total	28,855								11,600	40,455
Average										1,759
Maximum										3,130

Production (m3)

Well		
No.1	No.2	Total
1,148		1,148
1,477		1,477
1,833		1,833
1,636		1,636
1,012		1,012
940		940
1,068		1,068
1,865		1,865
1,856		1,856
1,646		1,646
1,721		1,721
1,598		1,598
1,544		1,544
1,511		1,511
1,915		1,915
1,974		1,974
850	1,028	1,878
	3,001	3,001
	3,103	3,103
	3,241	3,241
	3,427	3,427
	3,129	3,129
	2,906	2,906
25,594	19,835	45,429
		1,975

Unaccounted Losses

(m3)	(%)
260	22
236	15
52	2
-19	-1
27	2
251	26
-36	-3
536	28
606	32
238	14
268	15
77	4
227	14
31	2
327	17
35	1
54	2
14	0
447	14
267	8
297	9
585	18
194	6
4,974	10

* Recorded in Ethiopian Calendar

IC: Individual Connection

PF: Public Fountain

3.3 Water Supply Facilities Condition

3.3.1 General

Water source in this town is groundwater, and water supply is served by the piped water system. Existing water supply system consists of two boreholes, transmission facilities and distribution facilities as shown in figure 3.3.1.

3.3.2 Water Source

No.1 Borehole is equipped with a flow meter, and check valve, and the pumping rate was quantified at rate of 4.7 l/s. The existing submersible pump is driven by one on-site generator. The existing generator is an Indian-made generator with a capacity of 20 KVA.

No.2 Borehole including transmission facilities were constructed last year. The existing submersible pump is driven by an Italian-made on-site generator, with a capacity of 40 KVA. The borehole is equipped with a flow meter, check valve, and two gate valves. The pumping rate was quantified at rate of 3.7 l/s.

No information on the existing submersible pumps are available, because the pump investigation was not carried out due to the difficulty of taking out the pump from the borehole.

3.3.2 Transmission Facilities

The rising main was routed from #2 borehole to the service reservoir. In between this rising main, the pipeline of No.1 Borehole was jointed. It is reported that the rising main was constructed through community participation.

In addition, there is a boosting station between the rising mains. The existing boosting station consists of a collecting chamber with a submersible pump and a generating facility.

The existing collecting chamber is made of masonry with a capacity of 40 m^3, and the top slab R.C. Existing submersible pump is used for deepwell, so it should be replaced with a proper pump. This submersible pumps is driven by an Italian-made on-site generator, with a capacity of 30 KVA.

3.3.3 Distribution Facilities

Water stored in the service reservoir is delivered to the town by gravity. The existing service reservoir is located in the compound of the Health Center. It is a rectangular R.C. reservoir with a capacity of 100 m^3. No measurement appurtenance was provided, and no leakage was observed.

The distribution network is branched system with galvanized steel pipes and PVC. The diameters of the pipes range from DN 20 to DN 100. The lengths of pipelines are summarized as follows:

Table 3.3.1 Existing pipeline data

Diameter (mm)	Length (m)	Material
20	590	PVC
25	700	GS
40	290	-do-
65	580	-do-
80	4200	-do-
100	100	-do-

3.3.4 Service Level

Water service level is divided into two modes: individual connection and public fountain. There are 241 individual connections, and the individual connection is subdivided into 3 categories: private (172), commercial (56), and public institution (13). Individual connection is about 71% of the total consumption, and public fountain about 29%.

There are 7 operational public fountains. Four faucets per public fountain are provided.

3.3.5 Disinfection

There is no disinfection facility in the existing water supply system. It is reported that hypochlorite is occasionally being added in the service reservoir.

3.3.6 O & M

Bichena is classified as urban town, and the waterworks is under the control of Regional Office in Amhara Region. This office manages one satellite town.

Bichena WSS office is managing not only financial works but also maintenance works such as replacement of valve and meter. Any regular check up for the maintenance was not made except yearly inspection tour by regional office.

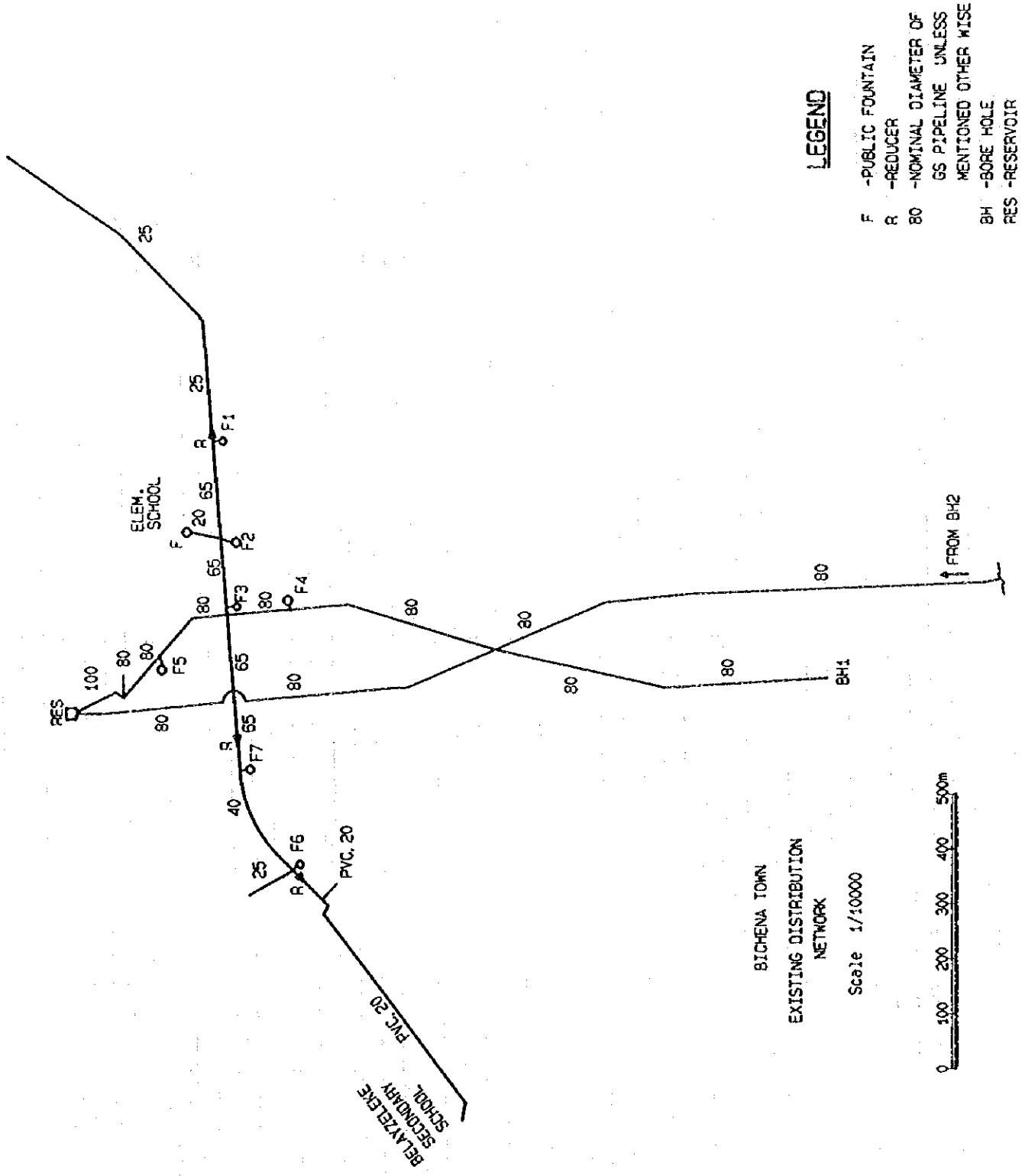


Figure 3.3.1 Schematic layout of Existing Facilities (No scale)

3.4 Sanitary Facilities Condition

3.4.1 Toilet Facilities

Bichena has a very poor sanitary condition. Most of the people use open-field and traditional pit latrines to dispose of their body wastes. At the middle of the town near the Total Fuel Station, Bichena used to have one small-size public toilet. This was filled-up in a very short time and a new one has not been constructed; and the people started to use the open area nearby, and excreta has become a common sight in the surrounding.

The Population and Housing Census of 1984 with an updated in 1993 has came out with the following as a survey result of the whole Bichena pertaining to sanitation.

Table 3.4.1 Distribution of Housing Units by Type of Toilet Facility in Bichena

Number and percentage	Type of Toilet Facility						
	Flush		Dry pit		None (open-field)	Other	Total
	Private	Shared	Private	Shared			
• Number	29	3	145	186	1,369	9	1,741
• Percentage (%)	1.7	0.2	8.3	10.7	78.6	0.5	100

It can be seen from Table 3.4.1 that majority of the people of Bichena(78.6%) use open-field for excreta disposal and 19% of the people use traditional pit latrines; whereas only 1.9% have flush toilets.

In the survey of 100 households in Bichena by the Team, the information obtained on toilet facilities is that:

- 56% of the households use open-field for discharging body wastes,
- 43% use traditional dry pit latrines,
- 1% use community toilet, and

These was no one household out of 100 surveyed that has flush toilet. One, therefore, can fairly conclude that sanitation in Bichena is very bad and need considerable effort by both the people and the official concerned to improve the situation.

The traditional pit latrines that are being used in Bichena are usually filled up within 2-3 years. The owners, if they have space, they dig new ones. Those who have money and can afford to pay they empty their toilets using vacuum truck from Debre Markos if they can arrange it. Because of critical shortage of vacuum truck in Debre Markos itself for its own use chances of getting one when needed are usually slim. In Bichena can arrange and get vacuum truck, and can empty their toilets, there are no places prepared for dumping the sludge. The vacuum truck dumps its load on any convenient places at the edge of the town. This creates environmental pollution, water contamination and serious health hazards.

The Population and Housing Census of 1984 has also surveyed the housing units in Bichena by types of materials used in the construction of walls, roofs and floors. The survey results indicate that 97% of the walls of the households were constructed out of wood and mud; 93% of the roofs are built out of corrugated iron sheets and 88%of the floors out of earth ad mud. The toilets are also follow the same pattern as of the households as regard to local construction materials with the exception of the flooring where considerable number of toilets use cement and concrete.

3.4.2 Other Sanitary Facilities

Dry solid wastes are mostly dumped in Bichena everywhere. The survey of 100 households carried out by the Team at Bichena revealed that 68% of households throw their refuse anywhere; 22% place in open pits; 3% in covered pits and only 7% of the households burn their dry solid wastes.

The same household survey of 100 housing units showed also that 84% of the households throw their sullages anywhere it is convenient, 10% in pits, 5% in drain and 1% in vegetable garden. Most of these sullages accumulated and have become places of breeding for flies and insects, have very bad odours and are very displeasing sights. They have created environmental pollution, caused water contamination and have become serious health hazards specially for children.

Bichena does not have abattoir. People slaughter meat animals in any convenient places and throw the wastes nearby. These have become sources of pollution and hazardous to health.

Except for the main road that passes through Bichena , no adequate drainage facilities are available along the secondary roads within the town. Waste dry materials and various types of rubbishes are seem dumped along the streets blocking the passages for water. This situation has become the causes of formation of stagnant water during the rainy season. Most of the low-lying areas in the town such as the areas east of the main road have also drainage problems due to formation of serious of ponds during the rainy season.

There are no as such industries in Bichena and therefore there are no industrial wastes.

3.5 Organization and Management

It is advised to refer to Tables 1 and 2 of Appendix-5 when you read this section.

The number of personnel for the Water Supply Service of Bichena is 20, which is one of the largest among the 11 towns. Its breakdown by position/function is shown below.

Table 3.5.1 Number of Personnel and Positions/Functions

Positions/Functions	Gender		Type of Employment		
	M	F	Permanent	Contract	Temporary
1. Head, WSS	1	0	1	0	0
2. Administration					
Head	1	0	1	0	0
Admi. clerks	0	2	2	0	0
Store keeper	0	1	1	0	0
Guards	5	0	3	2	0
Cleaner	0	1	1	0	0
Sub-total	6	4	8	2	0
3. Finance					
Head	1	0	1	0	0
Cashier	1	0	1	0	0
Meter reader	1	0	1	0	0
Water sellers	1	2	3	0	0
Sub-total	4	2	6	0	0
4. Technical					
Head	1	0	1	0	0
Motor operators	2	0	2	0	0
Sub-total	3	0	3	0	0
Total	14	6	18	2	0

As the table shows, out of the total 18 persons or 90% are permanent workers and 2 or 10% are contract workers. Female workers are 6 in number or 30%. It is more than 27%, which is the average percentage of female workers in 11 towns. When one classifies the functions into administrative, financial and technical ones, the head of WSS being included in technical functions, their respective shares work out to 50%, 30% and 20%. On the other hand, their 11 town averages are 37%, 41% and 22%. It means that the share of administrative functions is higher and that of financial functions is lower compared to their respective 11 town averages.

Annual water production per worker, which is the broadest labor productivity indicator is calculated at 891 m^3. It is at the second lowest level. The monthly remuneration per worker is 170 birr, which is medium.

It follows from the above that the participation rate of female workers is higher than the average, but there is a serious problem, that is, the absolute shortage of water production. Because of it under the existing circumstances the number of personnel might be not commensurate with the level of water production. Especially, the number of administrative personnel might be very excessive.

3.6 Financial Condition of WSS

It is advised to refer to Tables 1 and 2 in Appendix-5 when you read this section.

The price of water is 1.25 birr per m^3 for all clients.

Production and consumption of water in the last fiscal year (Jul. 1993 to Jun. 1994) were 17,810 m^3 and 15,826 m^3 respectively. Each of them is one of the least among the 11 towns (NO. 3 from the bottom). Leakage ratio works out to 11.1%, which is perhaps the lowest. The daily water consumption as divided by population comes to 3.0 liter. This is one of the lowest (No. 3 from the bottom).

Income for the last year was 34,679 birr. The major sources of income are water sales (50.3%), service charge (20.8%) and public fountains (13.7%). Income per m^3 of water consumed works out to 2.19 birr, which is one of the highest among the 11 towns (No. 3). Bill collection rate is 96.8%, which is one of the highest (No. 3).

Expenditures for the same year were 71,591 birr. Major items of expenditures were salaries (56.9%), fuel (27.6%) and transport and per diem (3.4%). Expenditures per m^3 of water produced work out to 4.02 birr, which is at the second highest level, next to 6.57 birr in Debre Tabor. Income-expenditure ratio comes to 48.4%. This is the second lowest, next to Debre Tabor.

The number of personnel is 20. It is one of the largest (No. 3) among the 11 towns. Annual water production per worker is calculated at 891 m^3, which is at the second lowest level, next to 663 m^3 in Debre Tabor. Annual income per worker is 1,735 birr, which is the lowest. Expenditures per worker are 3,580 birr, which is on the low side. Average monthly salaries are 170 birr. It is medium among the 11 towns.

It follows from the above that managerial control is strictly applied as evinced by high earnings per unit water sales, a low leakage ratio and a high bill collection rate. However, a dire limited supply of water and an excessive workforce nullify all such endeavors, precipitating financial performance deeply in the red.

3.7 Social Background and People's Awareness

3.7.1 Population and Social Composition

Bichena had a population of 14,629 at the time of the field survey. The population was virtually all Amhara. In the household survey, 99% of the respondents were Amhara and the remaining 1% Oromo. The religious mix of the respondents was 67% Christian and 33% Muslim. The land ownership of respondents was only 6% and the number of female headed households was 28%. The town had 6 Muslim EDERs, a number of Christian EDERs and one Sanbati (a Christian related social organization). There were two Kebeles, the business area being in Kebele 01 and therefore containing slightly more wealthy people. The rest of the population was mixed, poor with rich and Muslims with Christians. According to the household survey, Christian male and female headed households were

generally the poorer than their Muslim equivalents. Only 3 female Muslim headed households were recorded in the household questionnaires.

3.7.2 Sanitary Condition

Many people in Bichena did not have latrines, especially the poor, those in rented housing. The household survey indicated that 58% of households practice open defecation. For most people in Bichena the issue of lack of affordability seemed to be a major block to latrine access. Lack of health awareness and lack of motivation were also pertinent. Not all groups were aware of the link between poor water and sanitation and ill health. Of the household survey respondents, 42% were aware of diarrhoeal disease prevention.

Some groups favored community latrines and said that they could manage them and keep them clean by themselves. The majority of groups preferred to share the facility by sex. People would prefer simple latrines to pour flush latrines, because it was thought to be difficult to manage water seal facilities for a large number of users (Group 1). Most groups said they could afford to consider having water in the latrines for cleaning purposes and to pay for the desludging of filled up latrines. However, many people expressed the need for some enforcement from the Authorities to make sure that people used the latrines and kept them in a sanitary condition. Some people were interested in loans to build private latrines, which are easier to look after and keep clean than community or public facilities, this was reflected by an 82% response in favor of loans for latrines.

If a public shower facility were available in the center of Bichena, the users would be men and women if the service was relatively inexpensive. This could be linked to a public latrine facility to serve the population in center of town and for visitors, as an income generation initiative.

3.7.3 Water Situation

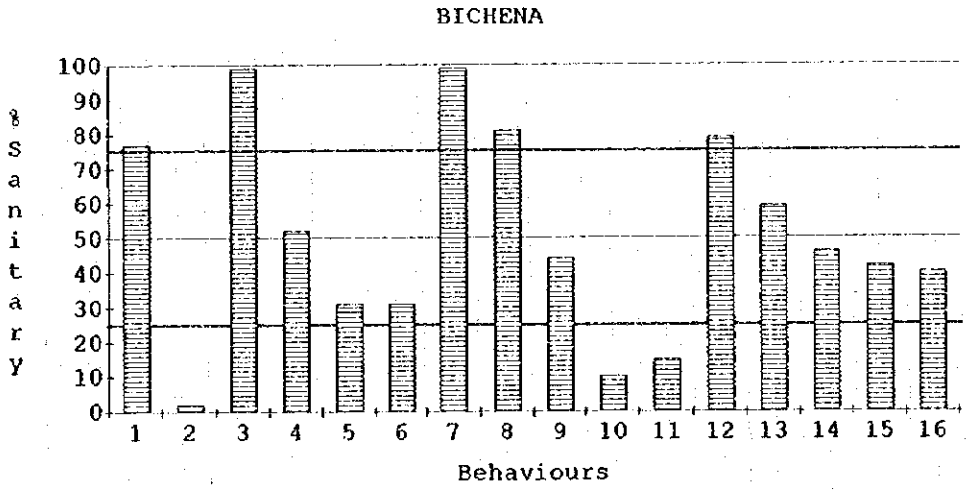
The water quantity situation in Bichena was serious during the site visit of July 1995 and people identified water as their top priority need. The center of the town was served with adequate numbers of public fountains and private connections but the service time was insufficient. The peripheral areas of the town center were some distance from the nearest piped supply and these people relied on springs and handdug wells for their water. The supply from the public fountains seems to be insufficient to supply the demand for the town, water points are operated on a rota for a few hours every other day. Public fountains did not operate on Sundays as water sellers were not contracted to work on Sundays. Most people relied on water from wells or springs to supplement the town water supply. Unfortunately statistics on well users are incomplete from the household survey.

The price of water was fixed at 10 cents for three average size clay pots from public fountains and for 10 cents for one clay pot from well vendors, water from some wells with poor water quality or taste problems were cheaper. Most groups were prepared to pay more for a better water supply service. The main requirement being longer water point service time, more public fountains and more private connections in the areas not already served by the piped water supply. Most people expressed an interest in community management of the additional public fountains. Both water collection and laundry were

undertaken by women and by female children. Men also undertook some of the laundry. Women and girls would benefit most from improved piped water availability.

3.7.4 Health Indicators

The town had a Health Center which served a population of 130,000 within the Woreda. Among the staff there were three sanitarians. The sanitation program has had serious problems due to a lack of budget, and an alleged lack of motivation from the Sanitarians themselves. Intestinal Parasites and diarrhoeal disease were among the top 10 most common diseases of people presenting at the health center, although TB was the most common disease (20% of all patients) in 1994/5. The health status was worse for people in the town than for those living in the surrounding rural areas. The town population had a relatively low level of sanitary awareness compared with other towns in the study. The indicator sanitary behaviors reported in the household questionnaires are recorded in Figure 3.7.1.



No.	SANITARY BEHAVIOURS	%Sanitary
1	Access to piped water	77
2	Use piped water supply always	2
3	Covered water container	99
4	Water scoop kept off the floor	52
5	Handwashing with soap after defecating	31
6	" after handling childrens stools*	31
7	Covering cooked food during storage	99
8	Not eating unwashed raw fruit and vegetables	81
9	Kitchen utensils stored off the floor	44
10	Rubbish burried or burned	10
11	Wastewater disposed in pit/drain/veg. garden	15
12	No animals kept in the house	79
13	Home not infested with flies	59
14	Latrine in use by household	46
15	Latrine in use by all household members	42
16	Infant's excreta disposed of in latrine*	40
TOTAL SCORE FOR SANITARY BEHAVIOURS		807

* As proportion of households with young children

Figure 3.7.1 Indicator Sanitary Behaviours

The town population had an average level of health awareness compared with other towns in the Study. The food hygiene situation seemed reasonable but handwashing was poor with only 34% of respondents washing their hands with soap after defecation and only 41% of people with young children washing their hands after handling children's excreta. Rubbish disposal was also a problem with 67% of respondents disposing of garbage indiscriminately. Latrine access and management of children's stools seemed to be worst for poorer households, particularly for low income male headed households. 10% of respondents requested sanitary education as part of any sanitation program.

All groups were aware of the health education program being carried out at the health center clinics. 34% of households in the survey had attended health education sessions in town and 37 out of 45 respondents said that they were satisfied with the sessions. Health Center staff thought they could be more effective if they had materials to make the health education imputes more interesting. Some school students had recently put on some health dramas for the community. At clinics there was also some outreach with Immunization (EPI) education.

Community Health Agents and Traditional Birth Attendants (TBAs), were working well as they had recently received refresher training courses and were being given incentives like free medicines. Their program includes environmental sanitation. The Health Center was hoping to construct community latrines in four parts of the town and to do a motivation campaign involving the Kebeles, with particular interest in motivating Kebeles to build latrines for the people living in Kebele rented housing.

The Church and Mosque leaders have been given health education training on HIV. Religious leaders were respected and it is hoped that people would listen to their teachings.

3.7.5 Education

Bichena had two elementary schools, one junior school, and one high school. The percentage of female staff at the schools interviewed in the questionnaire survey was 42% for elementary schools and 29% for the high school. There were 892 pupils at the high school of which 476 were boys and 416 were girls. The school operated on a shift system. In class 9 there were more girls than boys, in class 10 there were equal numbers and in classes 11 and 12 there were more boys than girls. Girls tended to have a higher drop out rate than boys and to do less well at their studies. Girls tended to have more work to do in the home and therefore had less time to study than their male counterparts. Boys were also more active in class.

The school had 12 clubs in total including a Red Cross Club and an Anti-AIDS Club led by the science teachers and supported by the staff of the health center when requested. A weekly health education session was scheduled for 1996. It was also planned to combine the Aids Club with the Red Cross Club to make a Health Club in the same year. This club could be used to raise the sanitary awareness of the students but not the parents as they have generally not been willing to attend school functions.

There had been PC water facilities at the school. The school also had one latrine for all to use, but girls did not use it. There was no budget available for the construction of a separate latrine for the girls to use.

3.7.6 Religious Institutions

The Debre Genet Church was already involved with the HIV/AIDS education program. Three Priests had been to Bahir Dar for a three day training and the Church had been handing out AIDS pamphlets. Priests were willing but have not been involved with sanitary education. They could facilitate health sessions on Sundays. However, the Priests felt that sanitary education would only be appropriate if given after improvements have been made to the water supply situation. The Priests felt that community latrines would not be a good option for the town and felt that public latrines managed by the Municipality would be better. People could help to build these toilets with either money or labor. The Municipality requested people to contribute money for public toilets recently but not all people were able to contribute cash. The Church has had problems with lack of water and have had request water from PF or PC users in the town center. They also did not have access to latrines.

The Mosque had a PC but without adequate water. They had no latrine. They felt that communal latrines would be appropriate and that the community would be able to manage and organize themselves. The Mosque had not been involved in health education but was willing to get involved. Females have been allowed to attend Solat at the Mosque on Fridays and so that would be a good time to reach all members of the Muslim community. Women from the Health Center would have to teach the women and men would have to teach men.

3.8 Socio-Economy

It is advised to refer to Tables 3 and 4 in Appendix-5 and Table 3.8.1 when you read this section.

3.8.1 Administrative Conditions

There are 19 governmental organizations excluding schools dealing with general administration, finance, education, health, water supply and sanitation, communications, police, justice, water resources development, agriculture, culture & sports, commerce, and municipal affairs.

The number of government employees is 499. It is a medium scale among the 11 towns. The number of them per 1,000 population works out to 57, which is on the high side. Their average monthly salaries are 374 birr, which is also on the high side.

This town has two Kebele. There is no NGO, but there are five public organizations.

3.8.2 Population

The population of the town is estimated at 14,629 based on the results of the cartographic census conducted by Central Statistical Authority in 1993. It belongs to a medium size group among the 11 towns. Ethnically, Amhara is overwhelming, occupying 99% of population, the remainder being Oromo. Religion-wise, 67% of the population is Christians and 33% Moslems. There are 2 churches and 2 mosques.

This is one of the Amhara and Christian towns.

The average family size is 6.2 persons. This is on the big side among the towns concerned. The area of the town is 200 ha. It is the second smallest, next to 68 ha in Mille. The population density is calculated at 73.1 persons/ha. This is the highest.

3.8.3 Educational Conditions

There are 2 kindergartens, 2 elementary schools, and 1 junior high school and 1 senior high school. The total number of pupils/students is 3,465. It is on the small side among the 11 towns. The number of pupils/students per 100 population is calculated at 24, which is at a medium level.

Literacy ratio and primary school enrollment ratio were 69.1% and 67.8% respectively according to the 1984 population census. Both are at a medium level.

Bichena is educationally at a medium level.

3.8.4 Medical Conditions

There are 1 health center and 2 pharmacies. The total number of medical personnel in the health center comes to 27, which is on the large side among the 11 towns. It means that there is 1.8 medical personnel for every 1,000 population. It is on the high side.

The types of diseases people suffer most are water-borne and sanitation-related diseases such as skin diseases, intestinal parasite and T.B., and respiratory tract infections such as pneumonia and upper respiratory tract infection. The number of top ten disease cases treated in the medical institutions in 1993/94 was 7,441, which is one of the lowest.

The estimated total number of cases treated last year in the hospital was divided by the estimated service population. It came to 15.3%, which is on the low side.

Under 5 mortality rate and life expectancy were 173.4/1,000 and 51.9 years respectively according to the 1984 population census. The former is one of the highest (No. 3). The latter is the second lowest, next to 47 years for Dupti.

Ratio of households more or less using septic tanks and pit latrines is 45.0%. This is the second lowest, next to 39.0% for Aykel.

The above tells that such health/sanitary indicators as mortality rate, life expectancy and dissemination rate of sanitation facilities are at a low level. However, medical environment is good in terms of the high number of medical personnel per unit population and the low incidence of diseases.

3.8.5 Economic Conditions

The number of hotels and restaurants is 47 (11.4%), that of shops 337 (81.4%), that of cottage industry 26 (6.5%) and that of others 3 (0.7%), adding up to 414 (100.0%). This total number of commercial/industrial establishments is medium among the 11 towns. The total number per 1,000 population comes to 28, which is on the low side. The number of hotels and restaurants per 1,000 population is 3, which is one of the lowest.

It appears that there are no encouraging indicators regarding the economic activities.

Major occupations in the town are trade, day laborers and government employees.

Major product is flour. Major marketable items are agricultural products such as tef, wheat, peas, beans and chick peas, livestock such as oxes, cows, sheep, goats, donkeys, and chickens, etc.

The market is held twice in a week. 4,000-5,000 and 10,000 people are said to gather on Thursday and Saturday respectively.

The average monthly household income is 323.9 birr. This is the second highest among the 11 towns, next to 334 birr in Dupti.

3.9 Town Planning and Development

The master plan for town planning has been formulated in the era of the Imperial government. According to the field survey, it is expected that seventy percent of the current master plan has been completed as shown in Figure 3.9.1.

The electric power is now supplied to the Centers by the hydroelectricity by EELPA, but the existing water supply facilities is operated by the on-site generators. The future water supply facilities at the target year of 2005 and 2010 will be operated by the hydroelectric power.

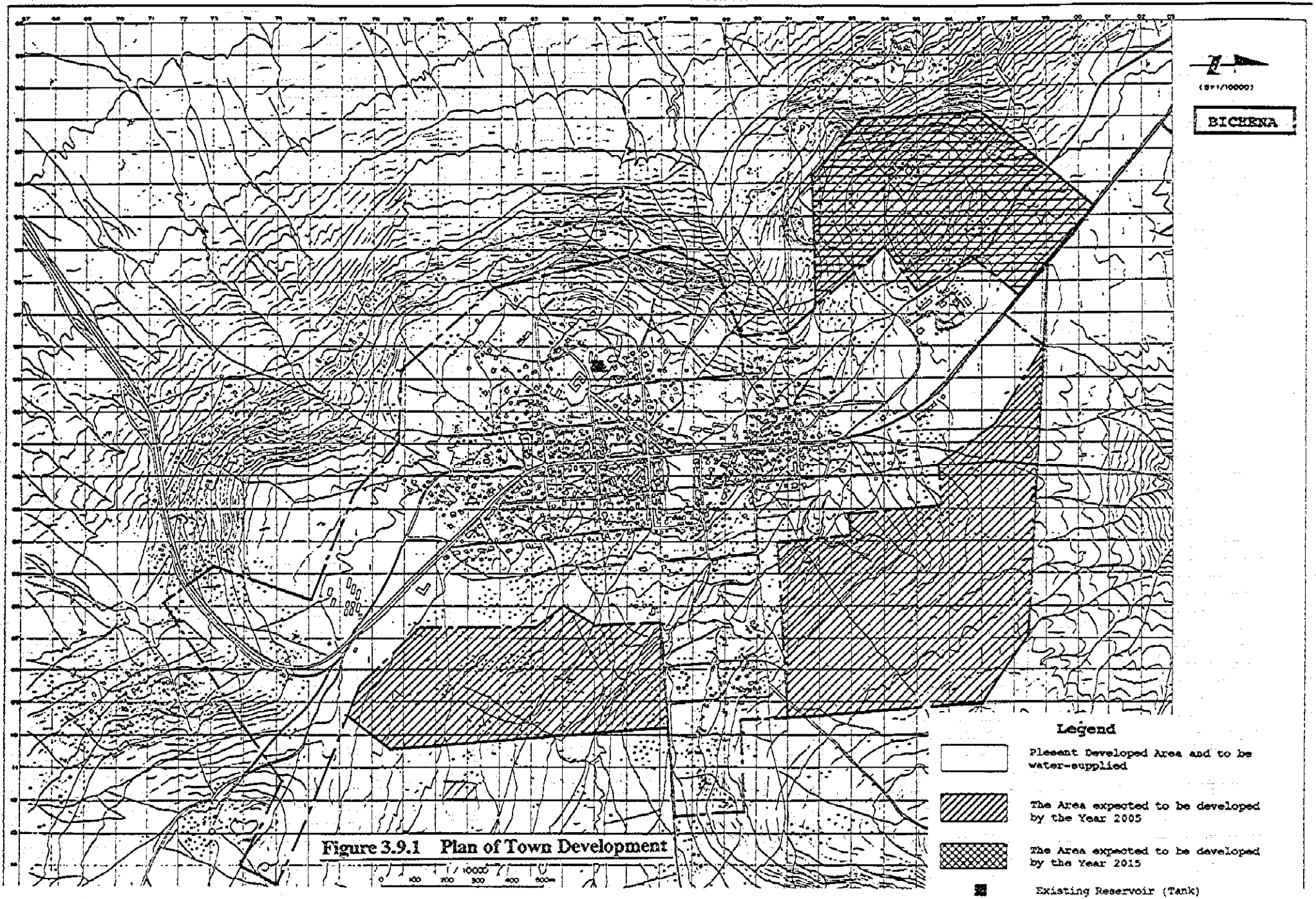


Figure 3.9.1 Plan of Town Development

Chapter 4 Plan of Water Supply System

4.1 Water Demand Projection

4.1.1 Population Projection

The population of Bichena was 7,951 in 1984 according to the results of the 1984 Population Census. The census is the first one the Ethiopian government has ever took.

Before 1984 no population figures are available so far as those of Bichena are concerned. Central Statistical Authority (CSA) published 1974 population estimates for those towns whose population was supposed to be more than 2,000. The population of Bichena was considered to be below 2,000 in that year.

Since 1984 also CSA published its own estimates of population. According to them population of the town in 1992 and 1993 was 14,900 and 15,811 respectively.

In 1993 to 1994 CSA conducted the Cartographic Census for all the towns over the nation, using its own staff just before the 1994 Population Census. CSA says the results of the former is dependable, even more than those of the latter.

According to the Cartographic Census the population of the town was 13,094 in 1993. When one uses the figures, the average annual population growth rate during the 9 years from 1984 to 1993 works out to 5.70%. The JICA Study Team projected future population of the town based on the rate.

In October, 1994 the second Population Census was carried out. The results are not yet published. There was no way for the team to get even the preliminary figures of the census for Bichena. Therefore, the team projected the 1995 population using the 1984 to 1993 average annual growth rate. It came to 14,629.

Regarding the future development of the town, the Fincha - Debre Markos - Bichena Hydro-Electric Power Project with a substantial capacity will be completed at the end of this year. In anticipation of it flour mills, oil factories and others are going to be constructed.

As the average annual population growth rate 1995 to 2000 5.5% was adopted based on the average annual population growth rate 1984 to 1993. The more a projection is long-term, the more the incertainty increases regarding the projection. Therefore, one should be more cautious and conservative for a longer-term projection. In line with this reasoning the average annual population growth rates 2000 to 2005 and 2005 to 2010 were projected to be 5.0% and 4.5% respectively.

As a result the projected population of the town for 2000, 2005 and 2010 works out to 19,120, 24,403 and 30,411 respectively (Refer to Table 4.1.1).

Table 4.1.1 Population of Bichena

1. Past Population

1984 Population Census	1993 Cartographic Census	Average Annual Growth Rate 1984 to 1993
7,951	13,094	5.70%

2. Population Projection

1995	2000	Average Annual Growth Rate 1995 to 2000
14,629	19,120	5.5%
2000	2005	Average Annual Growth Rate 2000 to 2005
19,120	24,403	5.0%
2005	2010	Average Annual Growth Rate 2005 to 2010
24,403	30,411	4.5%

4.1.2 Water Demand Projection

(1) Domestic Water Demand

a) Population Projection by Service Modes

Based on the current population data by service modes, the population at the target years by modes is projected and estimated in the Table 4.1.2.

85% of the population is targeted at the year of 2010 to be served by the piped water system, and the ratio served by the traditional water source is estimated at 15%, considering the current ratio of the population served. Based on the the ratio of the households who are payable for the mode-wise water charge, target ratio of the sum of house and yard connections (YC) at the year of 2010 is 61%, and 18% of this ratio is house connection (HC).

Table 4.1.2 Population Forecast by Service Modes

	Population (%)							
	1995		2000		2005		2010	
HC	146	(1.0)	1,051	(5.5)	3,538	(14.5)	8,515	(28.0)
YC	3,015	(20.6)	4,837	(25.3)	8,492	(34.8)	14,901	(49.0)
PF	6,607	(45.2)	8,473	(44.3)	7,714	(31.6)	2,434	(8.0)
Sub total	9,768	(66.8)	14,361	(75.1)	19,744	(80.9)	25,850	(85.0)
TSU	4,861	33.2	4,759	24.9	4,659	19.1	4,561	15.0
Total	14,629	100.0	19,120	100.0	24,403	100.0	30,411	100.0

b) Projection of Domestic Water Demand

Water demand figure by service modes formulated by WSSA is applied for the projection, i.e, House Connection 60 lpcd, Yard Connection 35 lpcd, Public Fountain 15 lpcd. In addition, these figures multiply by 0.9, considering the natural condition (annual mean rainfall is more than 900 mm). Based on these conditions, the domestic water demands at the years of 2000, 2005 and 2010 are obtained as follows:

Table 4.1.3 Domestic Water Demand by Modes

	m^3/day (lpcd)							
	1995		2000		2005		2010	
HC	3.9	(26.4)	56.8	(54)	205.2	(58)	536.4	(63)
YC	44.3	(14.7)	154.8	(32)	288.7	(34)	551.3	(37)
PF	31.1	(4.7)	118.6	(14)	115.7	(15)	38.9	(16)
Total	79.2		330.2		609.6		1,126.7	
Average	26.4	(8.1)	110.1	(23)	203.2	(31)	375.6	(44)

(2) Non Domestic Water Demand

a) Current Non Domestic Water Demand

As a result of field survey, the following current non domestic water demand is obtained.

Table 4.1.4 Non Domestic Water Demand in 1995

Item	Unit	Nos.	Demand (m^3/day)	Remarks
School	5 l/person	3,465	17.3	
Hospital	20 l/staff	29	0.6	
Hotel	100 l/bed	40	4.0	10 beds/place × 4 places = 40 beds
Bar...	200 l/bar	43	8.6	
Mosque	5 l/visitor	400	2.0	200 visitors/place × 2 places = 400
Offices	5 l/person	499	2.5	
Total			35.0	

b) Non Domestic Water Demand in Target Years

The public and institutional water demand increase in a geometric ratio of population growth, and the commercial water demand increases in a geometric ratio of population growth plus 3%. Non domestic water demands in the target years are estimated as follows:

Table 4.1.5 Total Non Domestic Water Demand in Target Years

Item	Demand (m^3/day)				Remarks
	1995	2000	2005	2010	
School	17.3	22.6	28.8	35.9	Population growth rate
Hospital	0.6	0.8	1.0	1.2	-do-
Hotel	4.0	6.0	8.8	12.6	Population growth rate +3%
Bar, Tea shop	8.6	12.9	19.0	27.3	-do-
Mosques	2.0	2.6	3.3	4.1	Population growth rate
Offices	2.5	3.3	4.2	5.2	-do-
Total	35.0	48	65	86	

(3) Total Water Demand

Total water demand at the target years including the accounted losses are estimated as follows:

Table 4.1.6 Total Water Demand in Target Years (m^3/day)

	1995*	2000	2005	2010
Domestic	79	330	610	1,127
Non Domestic	12	48	65	86
Losses	10	42	92	214
Total	101	420	767	1,427

* Actual consumption

(4) Maximum Day Demand and Peak Day Demand

Taking the seasonal difference into account, the factor 1.2 is adopted for the projection of maximum day demand. Furthermore, the factor 1.6 is adopted for the projection of peak day demand. The maximum day demand and peak day demand at the target years are obtained as follows:

Table 4.1.7 Maximum Day Demand Peak Day Demand

Item	Factor	1995	2000	2005	2010
Average Water Demand (m^3/day)		101	420	767	1,427
Maximum Day Demand (m^3/day)	1.2	121	504	920	1,712
Peak Day Demand (m^3/hour)	1.6	8	34	61	114

4.2 Water Resources Development

4.2.1 Evaluation of Water Resources

Bichena has annual precipitation of 1,262.3 mm and annual ground water recharge of 429 mm in an average year. The perennial river near the town is Suha river. Although the river water is accessible for the water supply, it is not recommended at this stage to

utilize the water because treatment is necessary for the water supply. There are many shallow wells in the town. However, their yield is little.

In Bichena, ground water development is also feasible. The WSS has two operational wells i.e. BH No.1 and BH No.3 along Banja river. The yield of BH No.1 is about 1 l/s according to the operation record. The safe yield of BH No.3 is reported at 5 l/s. The geology is basalts of Ashangi group which is dissected by the linearments according to the aerial photograph interpretation. The primary permeability of volcanic rocks is low but it could be increased with secondary prosity caused by faults and fracture openings. It is expected that the rocks are fractured and weathered along the linearments as favorable as for ground water exploitation.

Geoelectrical survey was conducted at 17 points as shown in Drawing including the existing operational wells. The apparent resistivity curves are classified into three (3) groups. The curves of the first group, Station No.1, No,7, No.10 and No.11, show the bumpy shapes with low apparent resistivity values less than 10 ohm-m. These curves imply highly weathered and fractured basalt underlies. The second one, Station No.2, No.3, No.13, No.14 and No.15, shows the shape with which the values simply rise as the depth increases. These curves imply the fresh basalt underlies. The third one, Station No.4 No.5, No.6, No.8, No.9, No.12, No.16 and No.17, shows the bumpy curves with the values ranging from 10 to 50 ohm-m. These curves imply the existence of weathered basalt layer with ground water. The results of VES interpretation are shown in Appendices.

Considering the lineation, the result of VES and the watershed area, borehole sites are selected at VES St. No.6, No.10, and No.12 and the point where major linearments intersect i.e. Station No.18. Since the watershed area for Station No.6 is relatively small i.e. 5.13 km^2, the 5-year annual recharge of dry years is checked. It is estimated to be equivalent to 5,600 m^3/day, which is more than sufficient for the proposed new well and the operational well i.e. BH No.1 located in the upstream.

4.2.2 Strategy of Water Resources Development

The characteristics of the major aquifers of the operational wells and the proposed well sites are shown in Table 4.2.1.

Table 4.2.1 Characteristics of Aquifers

Well No.	Locations	Depths of Major Aquifers (GL-m)	Lithology of the Aquifers	Total Thickness of the Aquifers (m)	Permeabilities (m/day)	Remarks
1	VES St.9	1 - 21	Highly Weathered and Fractured Basalt	20	1	WSS BH No.1
2	VES St.5	12 - 21 21 - 42 42 - 56	Weathered and Fractured Basalt Gravel and Others Weathered and Fractured Basalt	44	1	WSS BH No.3
3	VES St.6	4 - 40 58 - 90※	Weathered and Fractured Basalt Highly Weathered and Fractured Basalt	34	1	-Ditto-
4	VES St.10	1 - 90※	Highly Weathered and Fractured Basalt	44.5	1	-Ditto-
5	VES St.12	5 - 10 10 - 16 16 - 90※	Highly Weathered and Fractured Basalt Weathered and Fractured Basalt Highly Weathered and Fractured Basalt	42.5	1	-Ditto-
6	St.18	assumed as same as above		42.5	1	-Ditto-

Note: ※ = The aquifer bottom is probably deeper than the figure.

The depths of the major aquifers of WSS BH No.3 were obtained from the geological log. The others were detected by the geoelectrical survey. For the site where the geoelectrical survey was not done, the data of their adjacent sites is referred. Excluding the existing wells, the thickness of major aquifers is reduced into a half because a part of basalts are highly weathered and may become clayish. The permeabilities are assumed at 1 m/day according to the design criteria. The optimal yields of the wells are estimated with the formula listed in the design criteria with a drawdown of 20m and diameters of wells to be 200 mm. The optimal yields of the wells are shown in Table 4.2.2.

Table 4.2.2 Optimal Yields and Water Levels of the Wells

Well No.	Optimal Yield (m^3/day)	Static Water Level (GL-m)	Dynamic Water Level (GL-m)	Remarks
1	61	9.35	29.35	WSS BH No.1
2	133	7.55	27.55	WSS BH No.3
3	412	8	28	New Well for Year 2005
4	539	6	26	-Ditto-
5	514	5	25	New Well for Year 2010
6	514	5	25	-Ditto-

The optimal yields of Well No.1 to Well No.4 totaling to 1,145 m^3/day covers the demands of year 2005. The total yield of all the wells will cover the demands of year 2010.

It is recommended to drill these two (2) wells i.e. Well No.3 and well No.4 because the sites of Well No.5 and Well No.6 are not accessible without a road construction.

4.2.3 Design of Water Source Facilities

The new deep wells are designed as follows.

(1) Casing

Fiber Reinforced Plastic (FRP) pipe is adopted considering its elasticity for the case that the drilled borehole is not straight.

The diameter of casing is decided at 200 mm, taking into consideration the outer diameter of submersible pump (standard 80 - 140 mm) and the allowance. The length of the pipe is six (6) m per piece.

(2) Screen

Corresponding with the casing, FRP screen is adopted. The opening ratio is 12% and the length is four (4) m per piece. The total screen length is longer than the calculated by the following formula.

$$Ls = \frac{\alpha \cdot Q}{10 \cdot A \cdot N \cdot V}$$

where
- Ls: Length of screen (m)
- Q: Pumping rate (l/s) (assumed equal to the optimal yield)
- A: Surface area of screen 0.66 m^2/m
- N: Opening ratio 0.12
- V: Inflow velocity 0.5 cm/s (assumed)
- α: Safety factor 3

The dimensions of the wells are summarized as shown in Table 4.2.3.

Table 4.2.3 Dimensions of Wells

Well No.		3	4	5	6
Pumping Rate	(m^3/day)	412	539	514	514
	(l/s)	(4.8)	(6.2)	(5.9)	(5.9)
Diameter of Well	(mm)	200	200	200	200
Casing Length	(m)	48	30	36	36
Screen Length	(m)	48	64	60	60
Well Depth	(m)	96	94	96	96
Drilling Diameter	(mm)	300	300	300	300

4.3 Plan of Water Supply System

The water supply system proposed for the center of Werota would be implemented in two phases: first phase (target year 2005) and second phase (target year 2010).

The water supply system, which is composed of intake facilities, rising mains and distribution facilities, is proposed in the first phase to meet the water demand.

The water supply system, which is composed of additional intake facilities and transmission facilities, is planned in the second phase to meet the water demand at the target year of 2010.

4.3.1 Water Supply System in 2005

(1) Boreholes

There are two potential sites for borehole and three shallow well as stated in chapter 4.2. Two potential sites for borehole will be constructed in the first phase. The groundwater pumped up is transferred to the new reservoir directly. The production rate planned is summarized as follows.

W1 (Existing Well)	61 m^3/day
W2 (Existing Well)	133 m^3/day
W3 (proposed)	412 m^3/day
W4 (proposed)	539 m^3/day
Total	1,145 m^3/day

(2) Borehole Pumps

Each borehole will be equipped with a submersible motor pump. The characteristics of the pumps to be installed are assumed as follows:

W1, W2 (Existing Well)	Q = 0.09 m^3/min., H = 120 m, P = 3 kW
W3, W4 (proposed)	Q = 0.38 m^3/min., H = 100 m, P = 5 kW

(3) Boosting Facility and Rising Mains

The booster pump with following capacity will be installed to transfer the water to reservoir. And the collecting chamber with the following capacity will be constructed as well.

Q = 0.32 m^3/min., H = 70 m, Dia = 100 mm, P = 11 kW 2 set

Rising mains will range from 75 mm to 150 mm and transferred water to the new reservoir. The total length is about 7,490 m.

(4) Reservoir

The existing reservoirs is used, therefore, the additional capacity of the reservoir is required to meet the water demand at the year of 2005, and the required capacity is about 160 m^3 including reserve for fire fighting.

(5) Distribution Network

The distribution network is designed for the peak hour demand and fire fighting case, according to the design criteria.

The layout of the network follows the existing roads. The pipe with Dia. 75 mm is adopted as the minimum dia., and the pipe with dia. 50 mm is automatically adopted for the small distribution zone. Existing galvanized steel pipes will be replaced, if necessary.

The layout of distribution network for the target year of 2005 is prepared and attached in the Drawings. The main pipelines planned are shown as follows:

Table 4.3.1 Distribution pipelines

DN (mm)	Length (m)
200	320
150	3,825
75	5,105
50	6,445

(6) Disinfection

Disinfection will be performed by the injection system directly into the outlet of the reservoirs. Daily consumption ratio of chemical will be estimated at about 1.1 kg and necessary more than 0.11 PPM at the end of distribution pipe.

(7) Administration Building

In order to manage daily basis waterworks such as operation works, bill collecting, a building is required to be built by the year of 2005. The building is preferable to be built in the center of the town, and it has a store room.

4.3.2 Water Supply System in 2010

(1) Borehole

Two boreholes will be additionally constructed in the second phase to meet the water demand at the year of 2010. The production rate planned is summarized as follows.

W5 (proposed)	514 m^3/day
W6 (proposed)	514 m^3/day
Total	1,028 m^3/day

(2) Borehole Pumps

The boreholes will be equipped with submersible motor pumps. The characteristics of the pumps to be installed are assumed as follows:

W5 (proposed)	Q = 0.36 l/min., H = 100 m
W6 (proposed)	Q = 0.36 l/min., H = 100 m

(3) Distribution Network

The layout of distribution network for the year of 2010 is not prepared in this Study. It is needed to revise the current master plan of the town planning to match up to current situation. It is, therefore, preferable to design a layout plan after revision of the master plan.

(4) Disinfection

Disinfection will be performed by the injection system directly into the reservoirs. Daily consumption ratio of chemical will be estimated at about 2.0 kg and necessary more than 0.11 PPM at the end of distribution pipe.

4.4 Implementation Schedule and Cost Estimation

4.4.1 Executing and Responsible Agencies

The executive agency of this Project is to be the Water, Mine and Energy Bureau of the Amhara National Regional Government, while the Ministry of Water Resources is to be responsible to coordinate and facilitate the implementation of the Project.

WSSD is to be responsible for the close coordination with the agencies concerned on the project approval, finance and project implementation. The Project would be required to be of great importance in the coordination of activities among the departments in the Ministry and between the central and regional offices concerned.

Prior to the implementation of the Project, the Project Manager is to be appointed under WSSD, who rests with the day-to-day works. Under the manager, aiming at the smooth implementation, coordination be maintained among such departments/services as Planning & Project, Administration & Finance, Contract Administration, Design and WSSD. The Project Manager be also required to keep close relationship with regional and town offices concerned.

4.4.2 Construction Schedule

The construction works for pipeline and reservoir related to water supply works have been carried out mostly by manual labor in Ethiopia. However, it would be recommended to introduce certain number of construction machines in order to speed up the construction works.

As this Project requires urgent intermediation to counteract the current deteriorating water supply condition, the aforementioned measures shall be employed for the purpose of keeping-up smooth execution of the construction works.

The construction schedule is divided into two stages; namely, 1) preparation of finance including the foreign currency portion and detail design accompanied with tender

document, and 2) implementation of the Project. The schedule is proposed in the following, taking into consideration the above two stages and the construction amount.

First stage : Preparation in 1996
Second stage : Implementation after 1996 with reference to the priority among Eleven Centers

4.4.3 Project Construction Cost

The Project cost is estimated with both local currency and foreign currency. The unit price is estimated with reference to the standard unit price specified in Guideline for Preparation of Project, WSSA, July 1991. The unit price in this Project is price-escalated from the guideline prices based on the inflation rate shown in Economic Sensus between 1991 and 1995. WSSD's overhead, design and supervision fees and physical contingency are estimated according to the guideline.

In respect of foreign currency portion, the cost is required for the preparation of construction equipment and machinery, and procurement of such equipment and material as pump and pipe. Also, fuel, cement and other local materials made of imported row material are partly counted into foreign currency portion.

Engineering staff will be required for the detail design work and the implementation of the Project, since the Project is relatively large in the scale comparing to those existing water supply system. Consultant will also be employed by WSSD, MWR and be responsible for the all necessary work to be required and cooperate together with the WSSD's engineers.

Total project costs regarding water supply in years of 2005 and 2010 are summarized in Table 4.4.1.

Table 4.4.1 Total Project Cost of Water Supply in Thousand Birr

Year	F.C.	L.C.	Total
2005	11,245	6,532	17,777
2010			10,917

Note: Transportation Cost for Construction Equipment, Vehicles and Office Equipment are not included.

In this Study, sanitary improvement was also designed and required costs are summarized in Table 4.4.2. The costs are composed of 1) toilet facilities to be constructed in schools, medical institutions and public, 2) vacuum track, 3) refuse disposal track, 4) sludge dumping site, 5) refuse disposing site and 6) refuse collecting bins. Household sanitary facilities such as toilet (including community type) and waste water disposal pit shall be managed by the individuals or otherwise subsidized. Although drainage facilities are important, those are to be managed by Municipality and community participation in coordination with WSS. Therefore, the cost does not include the drainage facilities.

Table 4.4.2 Total Project Cost of Sanitary Facilities in Thousand Birr

Year	Cost
2005	1,553
2010	448

4.5 Financial Analysis

4.5.1 Financial Plan

(1) Estimation of Revenues

(a) Determination of Water Tariff

It was decided that there will be three water prices. One will be applied to house connection owners and non-domestic clients. The second and the last will be applied to yard connection users and public fountain users respectively.

The water tariff was so constructed that house connection owners and non-domestic clients will cross-subsidize yard connection and public fountain users, and yard connection users will, in turn, cross-subsidize public fountain users.

The tariff was determined in such a way that house connection owners, yard connection users and public fountain users will pay 4%, 4% and 2% of their income for water respectively in the target year of 2010.

Eventually, it is recommended that the following tariff will be applied from 1999 onward:

Clients	Water Price (birr/m^3)
1. House Connection Owners and Non-Domestic Clients	3.43
2. Yard Connection Users	2.31
3. Public Fountain Users	1.48

Important information concerned such as average monthly household income, share of households, water consumption per household per month, payment for water supply per household per month and ratio of water payment to income by type of clients and by the target year is shown in Table 4.5.1.

(b) Projection of Revenues

The major income source of water supply services is as every one knows revenue from water charge.

It is calculated by (No. of households by year by type of clients) × (annual water consumption per household by year by type of clients) × (water price by type of clients) × (bill collection rate).

The number of households was estimated based on the service population projection in the other chapter.

Annual water consumption was estimated based on the water demand projection in the other chapter.

Water price is already mentioned above.

The bill collection rate in the future was assumed as 95%.

There is the second revenue source. It is the revenue from technical service charge. This is the installation charge of connections. They say that the charge is 40% of the material and transportation cost actually incurred.

The revenue is calculated by (No. of connections to be newly installed by year) × (average technical service charge per connection).

The number of connections to be newly installed every year is estimated based on the projected number of house/yard connection owners.

According to the field surveys conducted by JICA, the average technical service charge per connection worked out to 195 birr although the charge varies depending on the diameter and length of the pipe, distance, etc.

The third revenue source is the the revenue from meter rent. For every new connection installed a water meter will be rented. The rental fee is 1 birr per month.

There are other revenues such as those from material sales, contract fee, connection fee, road crossing, etc. They are assumed to be 2% of the sum total of the preceding three revenues.

Projected revenues by source are shown in Table 4.5.2.

(2) Estimation of Cost

There are two types of cost. One is capital cost and the other is operation and maintenance (O & M) cost.

Capital cost is required to construct and replace water supply facilities. O & M cost is an recurrent cost daily required for the proper functioning of water supply facilities.

(a) O & M Cost

Seven types of O & M cost can be identified.

The first is electricity cost. It is estimated that 71 birr, 130 birr and 241 birr will be daily required from in 2000, 2005 and 2010 respectively.

The second is fuel cost. It will not be required as there will be sufficient electricity so far as Bichena is concerned.

The third is disinfection cost. It is estimated that 7 birr, 12 birr and 22 birr will be daily required in 2000, 2005 and 2010 respectively.

The fourth cost is personnel cost. It is estimated that 25, 31 and 43 employees will be required for WSS in 2000, 2005 and 2010 respectively. It is recommended that the average monthly remuneration per employee will be 481 birr. It was worked out based on the standard salaries the authorities are now proposing for each type/position of personnel comprizing WSS.

The fifth is installation cost of connections. It is projected that 78, 175 and 325 connections will be annually newly installed from 1999 to 2004, from 2005 to 2009 and from 2010 onward respectively. Installation cost per connection is estimated at 488 birr on average.

The sixth is the purchase cost of water meters. For each connection to be newly installed one water meter will be required. The purchase price of a water meter widely varies depending on the diameter of the pipe and the country from which it was imported. It was assumed that it will be 276 birr based on the bulk purchase price of Indian imports.

The last is other cost including office supplies, uniform, per diem and travel, postage & telephone, transport, maintenance of office, motor house, etc. , insurance, cleaning items, etc.
It was assumed that the cost will be 10% of the six preceding cost combined.

(b) Capital Cost

Capital cost can be classified into initial cost and replacement cost. The former is required at the time of initial investment and the latter at the time of investment for replacement.

So far as the Project is concerned, replacement cost will be required every 15 years for water purification units only. The average life of other equipment and facilities is assumed to be 30 years, which is the assumed life of the Project.

The summary of the estimated initial cost is as follows:

(Unit : thousand birr)

Item	Foreign Components	Local Components	Total
1. Phase 1			
1) Construction Cost	8,538	4,510	13,048
2) Engineering Cost (12% of 1))	1,566		1,566
3) Contingency (5% of 1) + 2))	505	226	731
Sub-Total	10,609	4,736	15,345
4) Buildings		1,097	1,097
5) WSSD's Management Cost (2% of 1) + 2) + 3) + 4))		329	329
Sub-Total		1,426	1,426
Total	10,609	6,162	16,771
6) Water Purification Units (included in total)	10	15	25
2. Phase 2			
1) Construction Cost			6,354
2) Engineering Cost (10% of 1))			635
3) Contingency (10% of 1) + 2))			699
Total			7,688
Grand-Total			24,459

The Phase 1 Project will start in 1996 and end in 1998, while the Phase 2 Project will start in 2007 and end in 2009. The first year of project implementation is for detail design, and the second and third years are for the construction of facilities. The progress of construction work was assumed to be 50% for 1997/2008 and the remaining 50% for 1998/2009.

4.5.2 Financial Analysis

Financial statements (income statement and fund statement) were projected for 30 years starting in 1996.

In doing so, the following conditions were assumed:

1. External Loan for Initial Cost

   Ratio of Loan : 100%
   Grace Period : 10 years
   Repayment Period : 30 years
   Interest Rate : 1%

2. Governmental Subsidy to WSS

   65% of Initial Cost

It is to be noted that the cost related to the construction of accommodation facilities as well as WSSD's management is not included in the above initial cost. Such cost will be borne by the Ethiopian government and WSS will pay it back on the same repayment terms as in the case of external loan.

Also, it was assumed that te existing corporate income tax will be applied, including 40% tax rate on the before-tax income in case the income is over 50 thousand birr.

Further, inflation was not considered.

The results are shown in Table 4.5.3.

As it shows, WSS will be financially sound and stable in terms of earnings as well as solvency in the years to come except initial years, if all the above mentioned conditions, estimates and assumptions are met.

As representative managerial indicators, the weighted averages of the ratio of revenues to expenditures and the ratio of working capital to revenues for the 30 years from 1996 to 2025 work out to the following:

Revenues/Expenditures = 144.1%
Working Capital/Revenues = 32.1%

Generally, it will be all right if the ratio of revenues to expenditures is equal to or more than 100%, or preferably 110%. Also, it will be all right if the ratio of working capital to revenues is equal to or more than 10%.

It is to be noted that the above values exceed the required levels by a thick margin.

Table 4.5.1 Water Price and Ratio of Water Payment to Income

Item	1995	2000	2005	2010
1. Average Monthly Household Income (birr)				
1) House Connection Owners	1,178	1,110	1,076	1,004
2) Yard Connection Users	675	616	524	397
3) Public Fountain Users	306	295	261	220
2. Share of Households (%)				
1) House Connection Owners	1.0	5.5	14.5	28.0
2) Yard Connection Users	20.6	25.3	34.8	49.0
3) Public Fountain Users	45.2	44.3	31.6	8.0
3. Water Consumption/Household/Month (m^3)				
1) House Connection Owners	4.9	10.0	10.0	11.7
2) Yard Connection Users	2.7	6.0	6.3	6.9
3) Public Fountain Users	0.9	2.6	2.8	3.0
4. Water Price (birr/m^3)				
1) House Connection Owners	1.25	3.43	3.43	3.43
2) Yard Connection Users	1.25	2.31	2.31	2.31
3) Public Fountain Users	1.25	1.48	1.48	1.48
5. Payment for Water Supply/Household/Month (birr)				
1) House Connection Owners	6.1	34.5	34.5	40.2
2) Yard Connection Users	3.4	13.7	14.6	15.9
3) Public Fountain Users	1.1	3.9	4.1	4.4
6. Ratio of Water Payment to Income (%)				
1) House Connection Owners	0.5	3.1	3.2	4.0
2) Yard Connection Users	0.5	2.2	2.8	4.0
3) Public Fountain Users	0.4	1.3	1.6	2.0

Source: JICA

Table 4.5.2 Planning of Revenues

(Unit: birr)

Year	H./Y. Connec.	Public Founta.	Non-Domest.	Techni. Servic.	Meter Rent	Other Revenue	Total
1996	14,244	4,848	3,546	7,205	-	5,359	35,202
1997	14,529	4,945	3,617	7,205	-	5,440	35,736
1998	14,820	5,044	3,690	7,205	-	5,523	36,281
1999	112,885	36,318	33,968	15,193	9,159	5,720	213,243
2000	191,549	60,864	57,089	15,193	10,094	6,696	341,485
2001	248,299	60,567	61,133	34,220	12,200	8,328	424,746
2002	305,050	60,269	65,177	34,220	14,305	9,580	488,601
2003	361,801	59,971	69,220	34,220	16,411	10,832	552,456
2004	418,551	59,674	73,264	34,220	18,517	12,085	616,310
2005	475,302	59,376	77,308	34,220	20,623	13,337	680,165
2006	596,152	51,493	82,303	63,436	24,527	16,358	834,270
2007	717,003	43,611	87,298	63,436	28,430	18,796	958,575
2008	837,854	35,728	92,294	63,436	32,334	21,233	1,082,880
2009	958,705	27,846	97,289	63,436	36,238	23,670	1,207,184
2010	1,079,556	19,963	102,284	63,436	40,142	26,108	1,331,489
2011	1,079,556	19,963	102,284	0	40,142	24,839	1,266,784
2012	1,079,556	19,963	102,284	0	40,142	24,839	1,266,784
2013	1,079,556	19,963	102,284	0	40,142	24,839	1,266,784
2014	1,079,556	19,963	102,284	0	40,142	24,839	1,266,784
2015	1,079,556	19,963	102,284	0	40,142	24,839	1,266,784
2016	1,079,556	19,963	102,284	0	40,142	24,839	1,266,784
2017	1,079,556	19,963	102,284	0	40,142	24,839	1,266,784
2018	1,079,556	19,963	102,284	0	40,142	24,839	1,266,784
2019	1,079,556	19,963	102,284	0	40,142	24,839	1,266,784
2020	1,079,556	19,963	102,284	0	40,142	24,839	1,266,784
2021	1,079,556	19,963	102,284	0	40,142	24,839	1,266,784
2022	1,079,556	19,963	102,284	0	40,142	24,839	1,266,784
2023	1,079,556	19,963	102,284	0	40,142	24,839	1,266,784
2024	1,079,556	19,963	102,284	0	40,142	24,839	1,266,784
2025	1,079,556	19,963	102,284	0	40,142	24,839	1,266,784

Note: H./Y. Connec. = House/Yard Connection
Public Founta. = Public Fountain
Non-Domest. = Non-Domestic
Techni. Servic. = Technical Service
'-' = included in 'Other Revenue', if any

Table 4.5.3(1) Financial Statement

(Unit: thousand birr)

No.	1	2	3	4	5	6	7	8	9	10
Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Income Statement										
Revenue	35	36	36	213	341	425	489	552	616	680
Operation and Maintenance	73	74	76	245	256	350	363	375	388	401
Depreciation	0	98	197	197	197	197	197	197	197	197
Payment of Interest	0	0	0	0	0	0	0	0	0	0
Expenditure	73	173	273	441	452	547	559	572	585	597
Profit before Tax	-38	-137	-236	-228	-111	-122	-71	-20	32	83
Tax	0	0	0	0	0	0	0	0	0	0
Profit after Tax	-38	-137	-236	-228	-111	-122	-71	-20	32	83
Funds Statement										
Profit after Tax	-38	-137	-236	-228	-111	-122	-71	-20	32	83
Loans	576	3111	3111	0	0	0	0	0	0	0
Subsidies	1069	4453	4453	0	0	0	0	0	0	0
Depreciation	0	98	197	197	197	197	197	197	197	197
Sources	1606	7525	7524	-31	86	75	126	177	228	279
Capital Works	1644	6850	6850	0	0	0	0	0	0	0
Payment of Principal	0	0	0	0	0	0	0	0	0	0
Working Capital	-38	674	673	-31	86	75	126	177	228	279
Applications	1606	7525	7524	-31	86	75	126	177	228	279
Loan Liabilities	581	3729	6908	6977	7047	7117	7188	7260	7333	7406
Cash Balance	-75	600	1273	1242	1327	1402	1528	1706	1934	2213

Source: JICA

Table 4.5.3(2) Financial Statement

(Unit: thousand birr)

No.	11	12	13	14	15	16	17	18	19	20
Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
					Income Statement					
Revenue	834	959	1083	1207	1331	1267	1267	1267	1267	1267
Operation and Maintenance	552	577	602	627	652	379	379	379	379	379
Depreciation	197	197	237	278	278	278	278	278	278	278
Payment of Interest	6	40	73	70	66	63	59	55	52	48
Expenditure	755	814	912	975	996	719	716	712	709	705
Profit before Tax	79	145	171	233	335	547	551	554	558	562
Tax	0	0	0	0	0	0	0	0	0	0
Profit after Tax	79	145	171	233	335	547	551	554	558	562
					Funds Statement					
Profit after Tax	79	145	171	233	335	547	551	554	558	562
Loans	0	244	1223	1223	0	0	0	0	0	0
Subsidies	0	454	2272	2272	0	0	0	0	0	0
Depreciation	197	197	237	278	278	278	278	278	278	278
Sources	276	1040	3903	4006	614	826	829	833	836	840
Capital Works	0	699	3495	3495	0	0	13	13	0	0
Payment of Principal	29	185	343	347	350	354	357	361	364	368
Working Capital	247	156	65	164	264	472	460	460	472	472
Applications	276	1040	3903	4006	614	826	829	833	836	840
Loan Liabilities	7445	7541	8435	9339	9016	8691	8361	8029	7693	7354
Cash Balance	2460	2617	2682	2846	3110	3582	4041	4501	4973	5445

Source: JICA

Table 4.5.3(3) Financial Statement

(Unit: thousand birr)

No.	21	22	23	24	25	26	27	28	29	30
Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Income Statement										
Revenue	1267	1267	1267	1267	1267	1267	1267	1267	1267	1267
Operation and Maintenance	379	379	379	379	379	379	379	379	379	379
Depreciation	278	278	278	278	278	278	278	278	278	278
Payment of Interest	45	43	53	62	57	52	46	41	36	30
Expenditure	701	700	710	719	714	709	703	698	693	687
Profit before Tax	565	566	557	548	553	558	563	569	574	580
Tax	0	0	0	0	0	0	0	0	0	0
Profit after Tax	565	566	557	548	553	558	563	569	574	580
Funds Statement										
Profit after Tax	565	566	557	548	553	558	563	569	574	580
Loans	0	0	0	0	0	0	0	0	0	0
Subsidies	0	0	0	0	0	0	0	0	0	0
Depreciation	278	278	278	278	278	278	278	278	278	278
Sources	844	845	835	826	831	836	842	847	852	858
Capital Works	0	0	0	0	0	0	0	0	0	0
Payment of Principal	372	388	453	519	524	529	534	540	545	551
Working Capital	472	457	382	307	307	307	307	307	307	307
Applications	844	845	835	826	831	836	842	847	852	858
Loan Liabilities	7012	6651	6211	5693	5169	4640	4105	3566	3021	2470
Cash Balance	5917	6374	6756	7064	7371	7678	7986	8293	8600	8908

Source: JICA

Chapter 5 Improvement of Health and Sanitation

5.1 Plan for Sanitary Facilities

The sanitation situation in Bichena is very bad. The critical shortage of water supply in the town plays a considerable role in aggravating the sanitation situation. Therefore, any plan of improving the sanitary facilities should go hand-in-hand with the improvement of the water supply. The waste water production in liters per capita per day was estimated using the water demand data for each types of water supply services.

From the water demand and waste water production as indicated in Table 5.1.1, conventional sewerage system can not be introduced in Bichena even by the year 2010.

Therefore, the sanitary technologies envisaged for Bichena are on-site technologies such as drainage and waste water disposal pit.

Table 5.1.1 Water Demand in lpcd and Waste Water Production in lpcd for Bichena

Item	HC			YC			PF		
	1995	2005	2010	1995	2005	2010	1995	2005	2010
• Water demand (lpcd)	26.4	58	63	14.7	34	37	4.7	19	21
• Waste water generation rate (%)	66	74	75	63	67	68	60	64	64
• Waste water production (lpcd)	17	43	47	9	23	25	3	12	13

5.1.1 Plan of Toilet Facilities

The sanitary technologies planned for Bichena are categorized into four major groups:

- Improved Traditional Pit Latrines
- VIP Latrines
- Compost Toilets
- Flush Toilets

These technologies are related to the types of water supply services of house connections(HC), yard Connections(YC) and public fountain(PF). The proposed toilet facilities are considered for residential or domestic households as well as for non-domestic households taking the water supply services of HC, YC and PF into account.

Table 5.1.2 Proposed Sanitation System in Relation to Types of Water Supply Services for Domestic Households

Types of Water Supply Services	Proposed Sanitary System for Domestic Households
1. Traditional Water Sources + Public Fountain (PF)	• Improved traditional pit latrine • VIP latrine, single-pit or double-pit • Soakaway pit for sullage
2. Yard Connection (YC)	• VIP latrine, single-pit or double-pit • Compost latrine • Pour-flush toilet with simple water seal and on-site pit • Pour-flush latrine + soakaway pit • Soakaway pit for sullage
3. House Connection (HC)	• Pour-flush toilet + soakaway pit • Cistern-flush toilet + soakaway pit • Pour-flush or cistern-flush toilet + septic tank • Soakaway pit for sludge

In each category, the first sanitary technology proposed is generally the cheapest and the simplest. Those that can afford more can have the subsequent ones depending on their choices and paying capacity.

For communities, schools, bus, terminals, market areas, health facilities, government offices, hotels, restaurants, bakeries, pastries, bars, tej and tella drinking houses, etc. the sanitation technologies proposed are indicated in Table 5.1.3.

Table 5.1.3 Proposed Sanitation Technologies for Communities and Non-domestic Households

Category	Proposed Sanitation System
1. Communities	• VIP community latrine with washbasin
2. Schools & training centers	• VIP collective toilet with washbasin
3. Market & bus terminals	• VIP public toilet with washbasin or shower
4. Government institutions	• VIP latrine with washbasin • Cistern-flush toilet + soakaway pit • Cistern-flush toilet + septic tank
5. Commercials	• VIP latrine with washbasin • Pour-flush or cistern-flush toilet + soakaway pit • Pour-flush or cistern-flush toilet + septic tank
6. Hotels, restaurants, drinking place, etc.	• Collective VIP latrine with washbasin • Pour-flush toilet with washbasin + soakaway pit • Cistern-flush toilet with washbasin + septic tank • Soakaway pit for sullage
7. Hospitals, health centers, clinics	• Collective VIP latrine with washbasin • Pour-flush toilet with washbasin + soakaway pit • Cistern-flush toilet with washbasin + septic tank • Soakaway pit for sullage

5.1.2 Plan of Sullage, Dry Solid Waste and Drainage

(1) Sullage

Sullage is the waste water which does not contain excrete but comes out from each household. Sullage always contains some pathogens though the concentration is much lower than that in sewage. In Bichena, sullage is presently being dumped in front of the households or along the streets. This poses a health risk if it is allowed to continue to be dumped everywhere.

The plan considers sullage soakaway pits of various sizes depending on the size and type of households for its disposal. The sullage soakaway pits need to be properly lined with stone, adobe, and other local materials with open joints for the major parts of the depth leaving about 30 cm from the top for pointed lining. If the waste water or sullage is too much for the soakaway pits to handle, then drainage field channels should be used.

(2) Dry Solid Waste

In order to stop the present indiscriminate dumping of refuse and to prevent both environmental pollution and water contamination, three strategic sites just outside the skirt of the town on the east,west and south are proposed for preparing proper refuse dumping sites.

Refuse collecting bins should be placed at strategic locations within the community so that people dump their refuse. Then refuse collecting and disposing truck or animal-drawn cart should empty the bins to transport the refuse to the prepared dumping sites. This work has to be administered by close relationship of the community, the Kebele and the Municipality. The refuse at the dumping site should be burnt under close supervision of the Municipality in coordination with WSS.

(3) Drainage

Two types of drainage are considered here. The first is the use of drainage field channels for the areas where the soakaway pits have become ineffective due to excess of sullage or waste water. The sizes and numbers of the drainage field channels depend on the quantity of waste water to be drained after close follow up of the working of the soakaway pits. The second type of drainage is draining is draining the storm water. Most of the drainage facilities that were prepared during the construction of the main roads have been blocked by outside rubbishes that have been dumped on them. The first action required is to open-up the blocked drainage facilities and maintain them regularly to remain open. This would considerably help to reduce the formation of stagnant water, and there by reducing or eliminating the sources for breeding of insects and flies. There are roads within Bichena that do not have any means of drainage facilities. These roads should have side ditches and cross drainages to drain the water whenever storm (rainfall) occurs.

5.2 Financial Plan for Sanitary Facilities

To estimate both the capital cost of building the sanitary facilities and the annual operation and maintenance cost, based on the 1995 prices, the following assumptions have been made.

- The calculated waste water flows for Bichena are too low to justify the installation of conventional sewerage system in Bichena. On account of this, the sanitary facilities proposed for Bichena are on-site sanitary technologies.
- Those households that do not have any toilet facilities in Bichena at present are assumed to have one type of toilet facility by the year 2010.
- Sanitary technologies that are new to the culture of the people living in Bichena are to be introduced gradually and with proper prior education as to the benefits and usefulness of the new technologies. Social acceptability of the new technology has to be confirmed prior to its introduction.
- Proposals for the appropriate sanitary technologies are drawn up based on the types of water services rendered in Bichena.
- The households in the same water service category can have toilets of the standard they can afford to pay for.

5.2.1 Households

From projected population of Bichena for target years of 2005 and 2010, households have been estimated using the family size for each type of water services.

Table 5.2.1 Households in Bichena for Target Years of 2005 & 2010 by Type of Water Services

Target Year	Households		
	HC	YC	PF
• 2005	570	1,370	1,240
• 2010	1,370	2,400	390

5.2.2 Estimate of Costs

(1) Capital Costs per Unit

For each type of toilet facility that is considered appropriate for Bichena and some equipment required, indicative costs for constructing each type of sanitary facilities and for purchasing the equipment are estimated as follows.

Table 5.2.2 Indicative Cost of a Type of Sanitary Facility or Equipment

Type of Sanitary Facility or Equipment	Indicative Cost of One Facility or Equipment (Birr)
1. Improved traditional pit latrine	1,000
2. VIP toilet, single pit	1,500
3. VIP toilet, double pit	2,000
4. VIP toilet, shared	15,000
5. VIP toilet, community	45,000
6. VIP toilet, collective (e.g. schools)	65,000
7. VIP toilet, public (e.g. market)	95,000
8. Compost latrine	2,500
9. Pour-flush + soakaway pit	3,000
10. Pour-flush + septic tank + soakaway pit	7,500
11. Cistern-flush + soakaway pit	4,000
12. Cistern-flush + septic tank + soakaway pit	8,500
13. Sullage soakaway pit	800
14. Drain field channel	4,000
15. Medium size vacuum truck	250,000
16. Medium size refuse collection and disposal truck	180,000
17. Animal-drawn cart	12,000
18. Refuse collection bin	250
19. Sludge dumping site	10,000
20. Refuse disposing and burning site	6,500

(2) Annual Operating and Maintenance Costs per Unit

The annual operating and maintenance cost is based on the assumption that most of the work is going to be done by labor only. For the equipment both running and maintenance costs are included.

Table 5.2.3 Annual Operating and Maintenance Cost per Unit

Type of Sanitary Facility or Equipment	Annual Operating and Maintenance Cost (Birr)
1. Improved traditional pit latrine	200
2. VIP toilet, single pit	250
3. VIP toilet, double pit	300
4. VIP toilet, shared	400
5. VIP toilet, community	700
6. VIP toilet, collective (e.g. schools)	800
7. VIP toilet, public (e.g. market)	3,000
8. Compost latrine	750
9. Pour-flush + soakaway pit	1,000
10. Pour-flush + septic tank + soakaway pit	1,250
11. Cistern-flush + soakaway pit	1,200
12. Cistern-flush + septic tank + soakaway pit	1,400
13. Sullage soakaway pit	100
14. Drain field channel	800
15. Vacuum truck	7,500
16. Refuse collection and disposal truck	8,500
17. Animal-drawn cart	3,000
18. Refuse collection bin	50
19. Sludge dumping site	2,000
20. Refuse disposing and burning site	2,500

(3) Assumptions for Estimating the number of Toilets to be Implemented in Bichena by the Year 2005 and 2010

To find the number of toilets to be implemented in Bichena by the year 2005 and 2010, the following assumptions have been made.

- By the year 2005

  - All schools in Bichena will have, at least, VIP collective toilets.
  - The Bichena Hospital toilet facilities will be rehabilitated; and the clinic and possibly a health center will have VIP collective toilets.
  - Bichena market area and bus terminal will have VIP public toilet.
  - 100% of households that have house water supply connections (HC) will have some kind of flush toilet.
  - 75% of the households that have yard water supply connections (YC) will have VIP or higher toilets.
  - 75% of households that use public fountain (PF) as a source of water supply will have improvement traditional toilets or VIP toilets.

- By the year 2010

  - 50% of households that have HC water supply will have some kind of flush toilets.
  - 50% of households that have YC will have VIP or higher toilets.
  - 100% of household that use PF will have improved traditional latrine or VIP latrine or higher grade toilets.

- In each category (HC,YC,PF), those that can afford more can have higher standard of toilets of their choices.

- All equipment will be replaced by this time.

(4) Total Capital Cost

Indicative capital costs for sanitary facilities for Bichena based on 1995 prices are shown in Table 5.2.4 for the year 2005 and in Table 5.2.5 for the year 2010.

Table 5.2.4 Capital Costs of Sanitary Facilities for Bichena for Year 2005

Facilities	No	Unit Cost (birr)	Total Cost (1,000 Birr)
• VIP collective toilets for schools	10	65,000	650
• VIP collective toilets for clinics and health centers	2	65,000	130
• VIP public toilet for market area and bus terminal	3	95,000	285
• 100% households with HC to have PF toilets	570	7,500	4,275*
• 75% households with YC to have VIP shared toilets or higher toilets	1,028	15,000	15,420*
• 75% households with PF to have VIP toilets	930	2,000	1,860*
• Vacuum truck	1	250,000	250
• Refuse disposal truck	1	180,000	180
• Sludge dumping site	2	10,000	20
• Refuse disposing site	3	6,500	20
• Refuse collecting bins	70	250	18
Total			23,108
Excluding Households' (*)			1,553

Table 5.2.5 Capital Costs of Sanitary Facilities for Bichena for the Year 2010

Facilities	No	Unit Cost (birr)	Total Cost (1,000 Birr)
• 50% of households in Bichena with HC to have flush toilets	685	7,500	5,138*
• 50% of Bichena households with YC to have VIP toilets or higher	1,200	3,000	3,600*
• 100% of Bichena households with PF to have VIP toilets	390	2,000	780*
• Replacement of vacuum truck	1	250,000	250
• Replacement of refuse disposal truck	1	180,000	180
• Replacement of refuse collecting bin	70	250	18
Total			9,966
Excluding Households' (*)			448

(5) Total Operating and Maintenance Cost

Indicative operating and maintenance costs for sanitary facilities for Bichena are shown in Tables 5.2.6 and 5.2.7 for the years of 2005 and 2010 each.

Table 5.2.6 Annual Operating & Maintenance Costs for the Year 2005

Facilities	No	Unit Cost (birr)	Total Cost (1,000 Birr)
• VIP collective toilets for schools	10	800	8.00
• VIP collective toilets for clinics and health centers	2	800	1.60
• VIP public toilet for market area and bus terminal	3	3,000	9.00
• 100% households with HC to have PF toilets	570	1,250	712.50*
• 75% households with YC to have VIP shared or higher toilets	1,028	400	411.20*
• 75% households with PF to have VIP toilets	930	300	279.60*
• Vacuum truck	1	7,500	7.50
• Refuse disposal truck	1	8,500	8.50
• Sludge dumping site	2	2,000	4.00
• Refuse disposing site	3	2,500	7.50
• Refuse collecting bins	70	50	3.50
Total			1,452.30
Excluding Households' (*)			49.60

Table 5.2.7 Annual Operating & Maintenance Costs by the Year 2010

Facilities	No	Unit Cost (birr)	Total Cost (1,000 Birr)
• Flush toilets for households with HC	685	1,250	856.25*
• VIP or higher toilets for households with YC	1,200	1,000	1,200.00*
• VIP toilets for households using PF	390	300	117.00*
• Vacuum truck	1	7,500	7.50
• Replacement disposal truck	1	8,500	8.50
• Replacement collecting bins	70	50	3.50
Total			2,192.75
Excluding Households' (*)			19.50

(6) Summary of Costs

- Capital Costs

Year	Cost in 1,000 Birr (Total)	Excluding Households'
2005	23,108	1,553
2010	9,966	448
Total	33,074	2,001

- Annual Operating & Maintenance Costs

Year	Cost in 1,000 Birr (Total)	Excluding Households'
2005	1,542.30	49.60
2010	2,192.75	19.50
Total	3,645.05	69.10

5.3 Application of Sanitary Education Program

In line with the approach detailed in the Main Report the following specific suggestions have been made for sanitary education in Bichena. These take into account the findings of the field survey work.

Bichena has a low level of health awareness in comparison with other towns in the Study. Despite this, sanitary behaviors are average. The impression was that sanitary education reaching everyone in Bichena would not be easy, as most people seemed to be active and out of the house during the days, leaving only the infirm and the elderly at home. Support for existing health education and a widening of the remit to include sanitary education through the Churches and Mosque will help. Strengthening coordination links with all concerned authorities by the setting up a Health/Sanitation Committee will also help. A budget will also be needed for sanitary education work in the town.

Improvements to be made in the drainage of stagnant water from areas in the town and the initiation of a refuse disposal mechanism, will simultaneously lead to improvements in sanitary behaviors.

Table 5.3.1 Sanitary Education Priorities in Bichena

Priority level	Type of Behavior	Blocks to Improved Practice
High	Piped water used always	Piped water not always available in sufficient quantities (WSS role) and not available when required by people (WSS role) at sites convenient for collection (WSS role).
High	Solid waste disposal in covered pits or burned	Sites not allocated for public waste disposal sites or not managed strictly (Municipality/ Woreda) Individuals (women) must be informed of where (Municipality/ Woreda) and how to dispose of waste (CPP/ all)
High	Waste water disposal in pits, drains or vegetable gardens	Drainage insufficient and disposal into drains not strictly managed (Municipality/Woreda) Individuals (women) must be informed of where to dispose waste water (Municipality/Woreda) and shown safe disposal techniques (CPP/all)
Medium-High	Handwashing with soap after defecation*	Personal hygiene (all) made more easy by making access to water and soap/ash nearer to the latrine (women's role) and by improving the status of the improved behavior (all)
Medium-High	Handwashing with soap after handling children's stools*	Personal hygiene (women and girls roles) made easier by improving access to water and soap/ ash nearer to latrine (women) and improving the status of such behavior (all)
Medium-High	Kitchen utensils kept off the floor	Domestic hygiene (women) although facilitated by shelf or similar available in kitchen to keep utensils on (women/ men) Construction of such shelves to be promoted (CPP)
Medium-High	Latrine coverage for all households*	Latrines to be built and maintained (Public-Municipality/Woreda) and (Community/private latrines-WSS/CPP/All made easier with examples of low cost latrines and loans (WSS))
Medium-High	Latrine use by all members of household*	Where there is a latrine, not all (children) of the household members use it. Use by all family members should be encouraged and status of latrine users promoted (CPP/all)
Medium-High	Sanitary disposal of children's excreta*	Small children should be encouraged to use the latrine as soon as they are able (all family members) Clearing up of children's excreta (women and girls role) must be encouraged and status of latrine users promoted (CPP/all))
Medium-Low	Water scoop kept off the floor	Domestic hygiene (women) although facilitated by shelf or similar available in kitchen to keep utensils on (women/ men) Construction of such shelves to be promoted (CPP)
Medium-Low	Fly Control	Related to solid and liquid waste disposal and excreta disposal (Municipality/Woreda /All role) Behaviors like covering of food and water pots during storage should be maintained (CPP/All)
	* High Priority for low income households	
	** High Priority for Muslim households	

Chapter 6 Reinforcement of Organization

It is advised to refer to Table 6.1.1 and Figure 6.1.1 when you read this section.

6.1 Comprehensive Organization and Management

The production of water will increase markedly under the proposed plan from 101 m^3/day in 1995 to 420 m^3/day in 2000, 767 m^3/day in 2005 and 1,427 m^3/day in 2010.

In line with it, the organizational structure will be enlarged, new functions will be added and the number of employees will be increased.

Basically the number of employees in the target years was estimated dividing water production by water production per employee. In estimating water production per employee, labor efficiency resulting from a greater production was assumed. It is proposed that sanitation functions be introduced in the organization of WSS from 2000 on. It means that more manpower will be required.

In adding sanitation functions to WSS the full name of WSS will be changed to Water Supply and Sanitation Service. But, the abbreviated name will be WSS as has been the case.

Considering the above factors, it is proposed that the number of employees will increase from 20 in 1995 to 25 in 2000, 31 in 2005 and 43 in 2010.

The organizational structure will get enlarged and more diversified. The ultimate organizational structure of WSS is shown in Figure 6.1.1.

As it shows, the organizational structure of WSS will be basically composed of 7 elements: Manager, Internal Audit, Customer Services, Administration Service, Financial Service, Technical Service and Sanitary Service. These are a skeletal structure or fundamental requirements of water supply and sanitation services. The functions of the last four big Services will get more diversified as years go by in accordance with greater water production.

6.2 Organization and Management of Water Supply

The number of personnel for water supply functions of WSS will be 23, 28 and 39 in 2000, 2005 and 2010 respectively.

Personnel for Administration, Financial and Technical Services will be basically distributed in such a way that their respective shares will be 30%, 35% and 35%.

A brief explanation on the ultimate organizational structure and functions will be given below:

The objectives of water supply functions of WSS are to supply sufficient piped water on one hand and to financially stand on its own feet. In this regard Customer Services and Internal Audit are typical functions of WSS. Besides them there will be three major Services.

Administration Service is composed of General Administration. Personnel, Storage and Legal Sections. General Administration Section will be in charge of secretarial/clerical work. Guards and sweepers also belong to this section. Personnel Section will be in charge of recruitment, assignment and training of personnel, and remuneration. Storage and purchasing of materials and supplies will be done in Storage Section. Such matters as complaints and penalties can be taken care of by Legal Section.

Financial Service controls Budgeting, Accounting, Financial Management and Operation Sections. Annual and monthly budget of income and expenditures will be prepared in Budgeting Section. Monthly and annual accounting of expenditures and income will be performed in Accounting Section. Financial Management Section makes analysis and evaluation of financial performances. Operation Section is in charge of meter reading, billing and collection, and cash water selling.

Technical Service covers Technical Records, Operation and Maintenance, Inspection and Work Sections, and Workshop. Records of equipment and supplies such as acquired dates, number, plans, dimension, breakdowns and repairs will be kept in Technical Records Section. Operation and maintenance of pumping stations, reservoirs, pipelines, public fountains, etc. will be taken care of by the section of the same name. Inspection of the above-mentioned facilities will be regularly done by the section of the same name. Repairing and manufacturing belong to Workshop. Works Section is in charge of rehabilitation/replacement/construction of facilities.

The number of personnel to be assigned by position/function in 2000, 2005 and 2010 is shown in the latter half of Table 6.1.1.

6.3 Organization and Management of Sanitation

The number of personnel for sanitation functions of WSS will be 2, 3 and 4 in 2000, 2005 and 2010 respectively.

A brief explanation on the ultimate organizational structure and functions will be given below:

An independent department called Sanitation Service will be introduced. The Service will be comprized of Public Relations, Loan Service and Maintenance Sections.

Public Relations Section will be in charge of the provision of information and public relations services to help people to install septic tank toilets and dry pit latrines. Loan Service Section will provide loan/subsidy to clients for the installation of septic tank toilets and keep related records. Maintenance Section will have a vacuum truck to regularly empty toilets and will regularly clean and maintain drainages.

The number of personnel to be assigned by position/function in 2000, 2005 and 2010 is shown in the latter half of Table 6.1.1.

Table 6.1.1 Personnel Requirements

1. Total No. of Personnel

Item	1995	2000	2005	2010
1. Total Production of Water (m^3/day)	101	420	767	1,427
2. Water Production per Worker (m^3/day/worker)	5.1	20	30	40
3. Coefficient	1	1.1	1.1	1.1
4. No. of Personnel	20	23	28	39
5. Additional Personnel for Sanitation	0	2	3	4
6. Final No. of Personnel	20	25	31	43

2. Breakdown of Personnel by Position/Function

Positions/Functions	1995	2000	2005	2010
1. Manager	1	1	1	1
2. Customer Services	0	0	0	1
3. Internal Audit	0	0	1	1
4. Administration Service				
1) Head	1	0	0	1
2) General Administration Section				
Secretaries/Typists/Clerks	2	1	1	1
Guards	5	5	6	6
Sweepers/Janitors	1	0	0	0
Drivers	0	0	0	1
Sub-Total	8	6	7	8
3) Personnel Section				
Recruitment and Assignment	0	0	0	1
Training	0	0	0	0
Remuneration	0	0	0	0
Sub-Total	0	0	0	1
4) Storage Section				
Store Keepers	1	1	1	1
Purchase of Materials/Supplies	0	0	0	0
Sub-Total	1	1	1	1
5) Legal Section	0	0	0	0
Total	10	7	8	11

2. Breakdown of Personnel by Position/Function (Continued)

Positions/Functions	1995	2000	2005	2010
5. Financial Service				
1) Head	1	1	1	1
2) Budgeting Section	0	0	0	1
3) Accounting Section				
Accountants	0	0	1	1
Cashiers/Treasurers	1	1	1	2
Sub-Total	1	1	2	3
4) Financial Management Section				
Financial Analysts	0	0	0	1
5) Operation Section				
Meter Readers	1	1	1	2
Bill Distributors/Collectors	0	0	0	2
Water Sellers	3	5	5	2
Sub-Total	4	6	6	6
Total	6	8	9	12
6. Technical Service				
1) Head	1	0	0	1
2) Technical Records Section	0	0	0	1
3) Operation and Maintenance Section				
Mechanics	0	0	1	1
Electricians	0	1	1	2
Motor Operators	2	4	4	4
Plumbers	0	1	2	2
Sub-Total	2	6	8	9
4) Inspection Section				
Water Meter Technicians	0	1	1	1
Leakage Detectors	0	0	0	0
Water Quality Analysts	0	0	0	0
Sub-Total	0	0	1	1
5) Workshop	0	0	0	1
6) Works Section				
Contracting	0	0	0	0
Designing/Drafting	0	0	0	0
Sub-Total	0	0	0	0
Total	3	7	9	13
7. Sanitary Service				
1) Public Relations Section	0	1	1	1
2) Loan Service Section	0	1	1	1

2. Breakdown of Personnel by Position/Function (Continued)

Positions/Functions	1995	2000	2005	2010
3) Maintenance Section				
Technicians	0	0	0	1
Drivers	0	0	1	1
Sub-Total	0	0	1	2
Total	0	2	3	4
Grand-Total	20	25	31	43

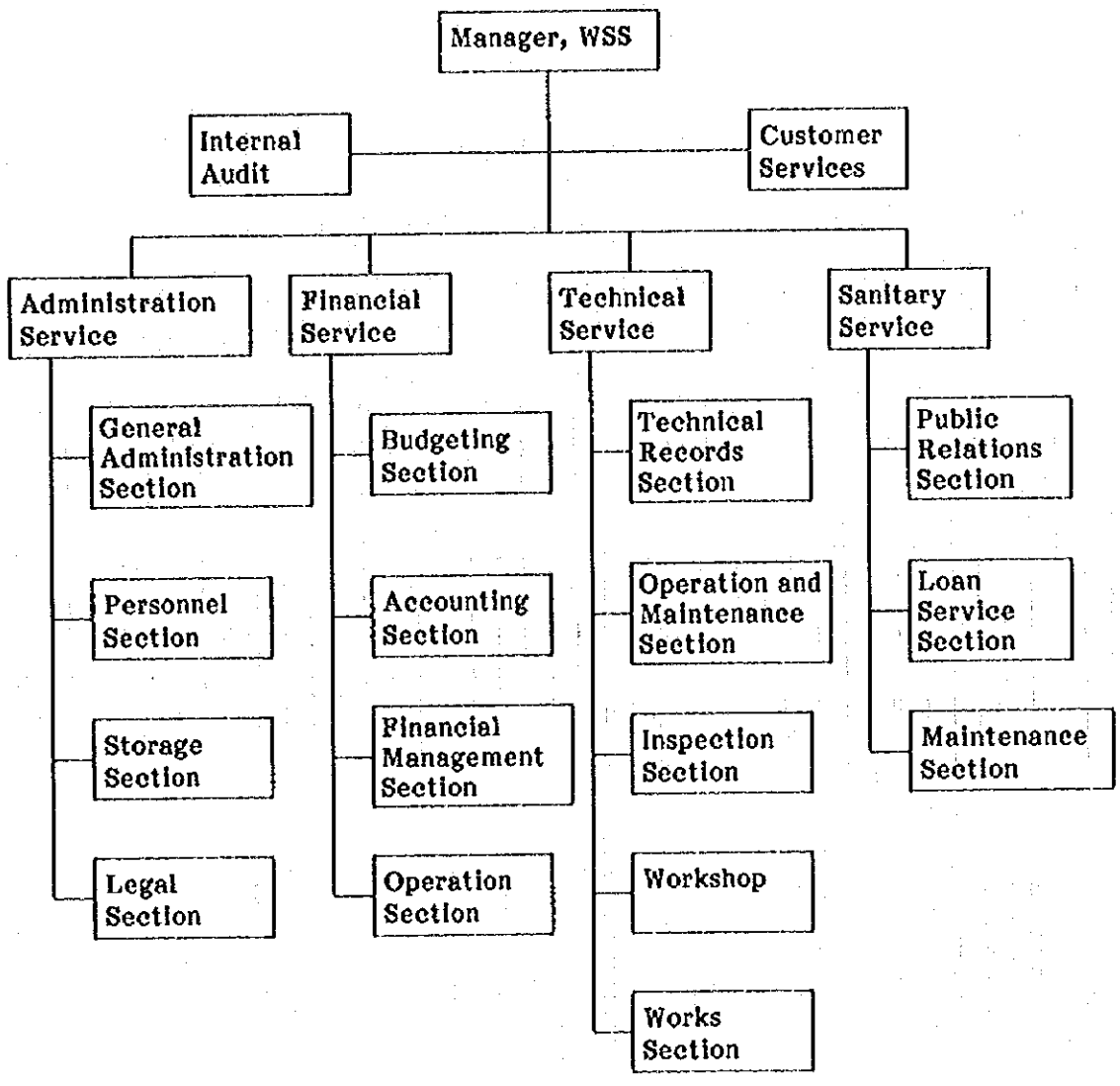


Figure 6.1.1 Proposed Model Organization Set-up of WSS

6.4 Community Building / Participation and WID

Based on the approach outlined in the Main Report and with reference to the findings of the field survey, the following recommendations have been outlined. They are specifically relating to Bichena with reference to community building and WID:

- The water supply situation in Bichena was serious. The project should make piped water available each day in adequate quantities at all water points. Additional public fountains to be constructed in areas where the piped supply does not reach at present. These could be community managed and could be constructed with labor and money contributions from the recipient communities. This would develop a sense of ownership towards the facility and initiate the community development process. Some private connections with adequate service time could be supplied to those who can afford them.

- Public latrines (not pour flush) to be opened with public shower in the center of town. The shower should provide some income to pay for a cleaner of the latrine and also to provide some capital for community development initiatives, e.g. for community entertainment or for income generation schemes.

- Community latrines mostly with water for handwashing should be built in areas where people are living in rented Kebele housing with priorities given to poorest members of the community. Again the community management of these facilities will strengthen the sense of community and initiate further development activities. Loans could be made available for people to construct simple private household latrines.

- The sanitation program will need to be supported with some enforcement by the Authorities, in particular the Municipality and the Sanitarians. This activity should be done in a sympathetic manner taking account of the blocks certain individuals and groups may have to prevent them from conforming. These may be those Christians in the lowest income groups.

Chapter 7 Project Evaluation

7.1 Economic Evaluation

7.1.1 Economic Benefits

(1) General

There are two major benefits deriving from the implementation of the Project.

One is the time benefit. Under the present circumstances people in the eleven centers more or less go to the far-away springs/rivers and/or public fountains every day to fetch water. The time spent in such a way comes to an enormous amount when it is aggregated as an annual total for the whole town.

If the Project is implemented, less people will go to the above-mentioned water sources as more people will use house connections or yard connections. That is to say, the time for water fetching will be greatly reduced.

The JICA Study Team calculated the time to be reduced annually for the whole town in the future years under the "with project" conditions.

Eventually, the team converted the time into financial terms. This is the time benefit.

Another is the reduction of water-borne diseases. When the Project is implemented, more people will have an access to clean piped water. It will reduce the opportunities for them to get in touch with contaminated water and contract such diseases as diarrhea, dysentery, typhoid and scabies.

However, how many such cases will be reduced is very hard to estimate. Therefore, the team just wants to remind people that such an important benefit will be realized in the "with project" case.

(2) Calculation of Economic Benefits

How the above-mentioned time benefit was calculated is summarized below:

As a result of the socio-economic questionnaire survey conducted by JICA, the following information was collected:

Users	Time spent at a time (min.)	Daily frequency (times)	No. of persons at a time
Public fountains	174	2.1	1.3
Springs/rivers	150	1.5	1.4

If the number of households using public fountains and the number of households using springs/rivers is estimated in both the "without project" and "with project" cases in the

target years, one can work out the total time spent fetching water every year in both cases by utilizing the above tabulated information.

The respective number of households using the above two water sources in the "with project" case was estimated based on the service population projection in the other chapter. The respective number of such households in the "without project" case was calculated on the assumption that piped water users will increase by 2% every year.

Then, the difference in the aggregated annual water-fetching time between the two cases was calculated for each year.

Finally, such a time was converted into financial terms by using the following information:

Monthly household income (birr)	Family size (persons)	Waking hours in a day	Time value per hour (birr)
A	B	C	D=A/30/B/C
324	6.2	16	0.1089

The results are shown in Table 7.1.1.

7.1.2 Cost

The cost can be divided into capital cost and operation and maintenance (O & M) cost.

Capital cost is huge compared to the economic benefits resulting from the reduction of water fetching time. If one could quantitavely incorporate the subdual of water-borne diseases, benefit related to WID and multiplier economic effect into benefits, then one could consider the total cost including capital cost. But, the reality is such that one considers O & M cost - actually, a part of it - only for the sake of convenience.

O & M cost consists of electric cost, fuel cost, disinfection cost, personnel cost, installation cost of connections, purchase cost of water meters and other cost. (For more details refer to 4.5.) It was estimated as an annual recurrent cost for future years.

It turned out that the whole O & M cost is too large in comparison with the above benefits. Eventually, personnel cost was picked up, representing O & M cost.

The personnel cost used here is the incremental one, that is to say, the difference between the personnel cost in the " with project " case and the personnel cost in the " without project " case.

(3) Economic Evaluation

Based on the data calculated in the above-mentioned way, cost benefit streams were prepared as shown in Table 7.1.2.

As it shows, the cumulative cost and benefits for 30 years come to 4,511 thousand birr and 15,175 thousand birr respectively. It means benefits are 336% of cost at the discount rate of zero.

That is to say, the cumulative benefits of the reduction of water fetching time for 30 years are 3.36 times as great as the cumulative personnel cost of WSS at 0 opportunity cost.

It is to be noted that time benefit resulting from project implementation is substantial, coming to more than triple the personnel cost of WSS.

Table 7.1.1 Saved Time and Benefit

Year	Saved Time (hours)	Benefit (birr)
1996	0	0
1997	0	0
1998	0	0
1999	289,980	31,570
2000	556,146	60,548
2001	929,887	101,238
2002	1,318,425	143,538
2003	1,722,503	187,531
2004	2,142,897	233,299
2005	2,580,579	280,950
2006	3,419,693	372,305
2007	4,274,110	465,327
2008	5,144,519	560,089
2009	6,031,637	656,670
2010	6,936,213	755,152
2011	6,936,213	755,152
2012	6,936,213	755,152
2013	6,936,213	755,152
2014	6,936,213	755,152
2015	6,936,213	755,152
2016	6,936,213	755,152
2017	6,936,213	755,152
2018	6,936,213	755,152
2019	6,936,213	755,152
2020	6,936,213	755,152
2021	6,936,213	755,152
2022	6,936,213	755,152
2023	6,936,213	755,152
2024	6,936,213	755,152
2025	6,936,213	755,152

Table 7.1.2 Cost Benefit Streams

CC=Capital Costs; OM=O/M Costs; CS=Costs; BF=Benefits
CF=Cash Flow (=BF - CS)

(Unit:thousand birr)

NO.	YEAR	CC	OM	CS	BF	CF
1	1996	0	0	0	0	0
2	1997	0	0	0	0	0
3	1998	0	0	0	0	0
4	1999	0	94	94	32	-63
5	2000	0	99	99	61	-38
6	2001	0	105	105	101	-4
7	2002	0	111	111	144	32
8	2003	0	117	117	188	70
9	2004	0	123	123	233	110
10	2005	0	129	129	281	152
11	2006	0	142	142	372	230
12	2007	0	155	155	465	311
13	2008	0	167	167	560	393
14	2009	0	180	180	657	476
15	2010	0	193	193	755	562
16	2011	0	193	193	755	562
17	2012	0	193	193	755	562
18	2013	0	193	193	755	562
19	2014	0	193	193	755	562
20	2015	0	193	193	755	562
21	2016	0	193	193	755	562
22	2017	0	193	193	755	562
23	2018	0	193	193	755	562
24	2019	0	193	193	755	562
25	2020	0	193	193	755	562
26	2021	0	193	193	755	562
27	2022	0	193	193	755	562
28	2023	0	193	193	755	562
29	2024	0	193	193	755	562
30	2025	0	193	193	755	562

7.2 Financial Evaluation

7.2.1 Calculation of FIRR

Regarding detailed information on revenues and cost, refer to Section 4.5.

(1) Initial Cost

It was assumed initially that the central government would provide subsidy to the Bichena WSS amounting to 90% of initial cost.

It is to be noted that the cost related to the construction of accommodation facilities as well as WSSD's management is not included in the above initial cost.

Based on the revenues and cost estimated in Section 4.5 under such an assumption, cost benefit streams were prepared for the 30 years starting in 1996.

Using them, financial internal rate of return (FIRR) was calculated. As a result, it worked out to 6.9%.

The value is judged to be a little too high in consideration of the nature and objective of the Project.

It is important for the central government to be paid back initial cost as much as possible, thus lessening its budgetary burden.

After repeated simulation, it was finally decided that the subsidy ratio of initial cost would be 65%.

(2) Final Results

Under the above-mentioned subsidy conditions, cost benefit streams were prepared as shown in table 7.2.1.

Using the streams, FIRR was calculated. As a result, the value of 3.8% was obtained.

The value exceeds 1%, which is the assumed interest rate of external loan by 2.8%. It is judged to be sufficiently and reasonably high considering the nature and objective of the Project.

7.2.2 Sensitivity Analysis

To see how the value will be affected under different circumstances, sensitivity analysis was conducted. The conditions and results are shown below:

Item	Conditions	Results	Difference from Base Case
1. Case 1	Benefits : -10%	FIRR: 2.4%	-1.4%
2. Case 2	Initial Cost : +10%	FIRR: 3.1%	-0.7%
3. Case 3	Progress of : 1997=70% Construction 1998=30%	FIRR: 3.9%	+0.1%
4. Case 4	Progress of : 1998=70% Construction 1999=30%	FIRR: 2.9%	-0.9%

In Cases 3 and 4 detail design will be done in 1996 and 1997 respectively.

As the table shows, the value of FIRR is robust enough by maintaining the level of thickly more than 1% under adverse circumstances conceivable.

Case wise, the shortage of revenues will deal the strongest negative impact on the financial feasibility of the Project, followed by the delayed progress of works and, then, cost overrun, while earlier completion of works will raise the feasibility by a little margin.

Table 7.2.1 Cost Benefit Streams

CC=Capital Costs; OM=O/M Costs; CS=Costs; BF=Benefits
CF=Cash Flow (=BF - CS)

(Unit:thousand birr)

NO.	YEAR	CC	OM	CS	BF	CF
1	1996	576	73	649	35	-613
2	1997	3111	74	3185	36	-3149
3	1998	3111	76	3187	36	-3150
4	1999	0	245	245	213	-31
5	2000	0	256	256	341	86
6	2001	0	350	350	425	75
7	2002	0	363	363	489	126
8	2003	0	375	375	552	177
9	2004	0	388	388	616	228
10	2005	0	401	401	680	279
11	2006	0	552	552	834	282
12	2007	244	577	821	959	137
13	2008	1223	602	1825	1083	-742
14	2009	1223	627	1850	1207	-643
15	2010	0	652	652	1331	680
16	2011	0	379	379	1267	888
17	2012	13	379	391	1267	876
18	2013	13	379	391	1267	876
19	2014	0	379	379	1267	888
20	2015	0	379	379	1267	888
21	2016	0	379	379	1267	888
22	2017	0	379	379	1267	888
23	2018	0	379	379	1267	888
24	2019	0	379	379	1267	888
25	2020	0	379	379	1267	888
26	2021	0	379	379	1267	888
27	2022	0	379	379	1267	888
28	2023	0	379	379	1267	888
29	2024	0	379	379	1267	888
30	2025	0	379	379	1267	888

7.3 Organizational Evaluation

The existing organizational situation related to water supply and sanitation in Bichena can be summed up as follows:

- The WSS of Bichena is expected to financially stand on its own feet. But, it is not given the power commensurate with financial independence.

- The WSS of Bichena is financially deeply in the red. As a result, workers are underpaid, they have little supplies and equipment for operation and maintenance and there is a shortage of skilled manpower.

- Sanitation functions in the WSS of Bichena have been totally neglected. But, the sanitary situation in the town is such that organizational/institutional countermeasures are urgently required.

- A key for a successful implementation of water supply/sanitation projects lies in community involvement. It seems that the authorities have not given proper consideration in this regard.

- Another key for a successful implementation of water supply/sanitation projects lies in female participation. It appears that the authorities have not been properly aware of it.

To rectify the above situation, the following organizational/ institutional measures have been proposed.

- Autonomy is a trump for a financially good performance. It is essential for the WSS to be institutionally given its own decision-making power regarding the revision of water tariff, hiring and firing of staff, remuneration, execution of small-scale rehabilitation or new works, purchasing of supplies and equipment, etc. Approval will be given by the regional organization, and it will be reported to the central organization.

- The fundamental conditions for any WSS to have a successful financial performance are to have a sufficient supply of water on one hand and to have a reasonable level of water price on the other. Both conditions are hopefully expected to be satisfied through the Project. If the WSS of Bichena has a successful financial performance and its own decision-making power as well, then the accompanying difficulties such as low remuneration, shortage of skilled manpower and little availability of equipment and supplies will be eventually overcome.

- The organization related to sanitation will be newly established in the organizational set-up of WSS after the Phase 1 Project is completed in 1998. It will perform loan service and promotion activities regarding the installation of sanitation facilities.

- Sanitary/Health Committee will be organized in the town. The members will be composed of representatives from schools, hospitals, Weroda council, municipality, the bank, central and regional water supply organizations, WSS and community. The chairman will be elected from Weroda council. The major objective of the committee is coordinating and unifying the related activities so that sanitary awareness of the townspeople and the installation of sanitation facilities will be effectively promoted.

- Public fountains to be newly constructed in future will be managed by the community if people are overwhelmingly in favor of it. According to the socio-economic questionnaire survey conducted by JICA, they strongly side with it. People will freed from the frustrations and constraints they experience every day today in connection with the opening hours, breakdowns and repairs, water tariff, etc. The community will have decision-making power in financial, personnel and technical terms subject to WSS's approval. The community is expected to financially stand on its own feet.

- Construction of community toilets will be promoted. Financial resources may come from the community itself or other sources. Sanitary/Health Committee and WSS will assist in the acquisition of fund. A strict financial management of the toilet will be required. The maintenance and operation, payment and collection of the user charge, the decision on user charge, etc. will be totally in the hand of the community. Sanitary/Health Committee and WSS will be always ready for helping the community in this regard.

- It is also proposed that the female participation ratio in the workforce of WSS, the community managed public fountain and the community toilet be more than 50%.

7.4 Technological Evaluation

The proposed water supply system is composed of relatively simple facilities, those of which are not quite different from existing ones. Although new material made of fiberglass reinforced plastic is to be introduced into such work as well casing, the light material could facilitate the construction work very smoothly. The material is also expected to be long life-span comparing to other conventional material, thus maintenance and renewal cost could be reduced in the long run.

In the Project, two and another two number of boreholes are newly required in years of 2005 and 2010 and those including existing ones are located with certain distance from each other or sometimes away from another. Therefore, mobilization is due required for the daily operation of those boreholes. In this regard, transportation must be strengthened by means of vehicle or motorbike, otherwise well attendant is additionally required in the number.