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

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

FINAL REPORT
(FEASIBILITY STUDY)

EXECUTIVE SUMMARY

FEBRUARY, 1996

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

Exchange Rate

1 US Dollar	=	6.3 Birr
1 US Dollar	=	94.5 Yen
1 Birr	=	15.0 Yen

November 1995

GOVERNMENT OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY(JICA)
FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
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PREFACE

This executive summary report presents the results of the Study on Eleven Centers Water Supply and Sanitation (the Study) which was 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.

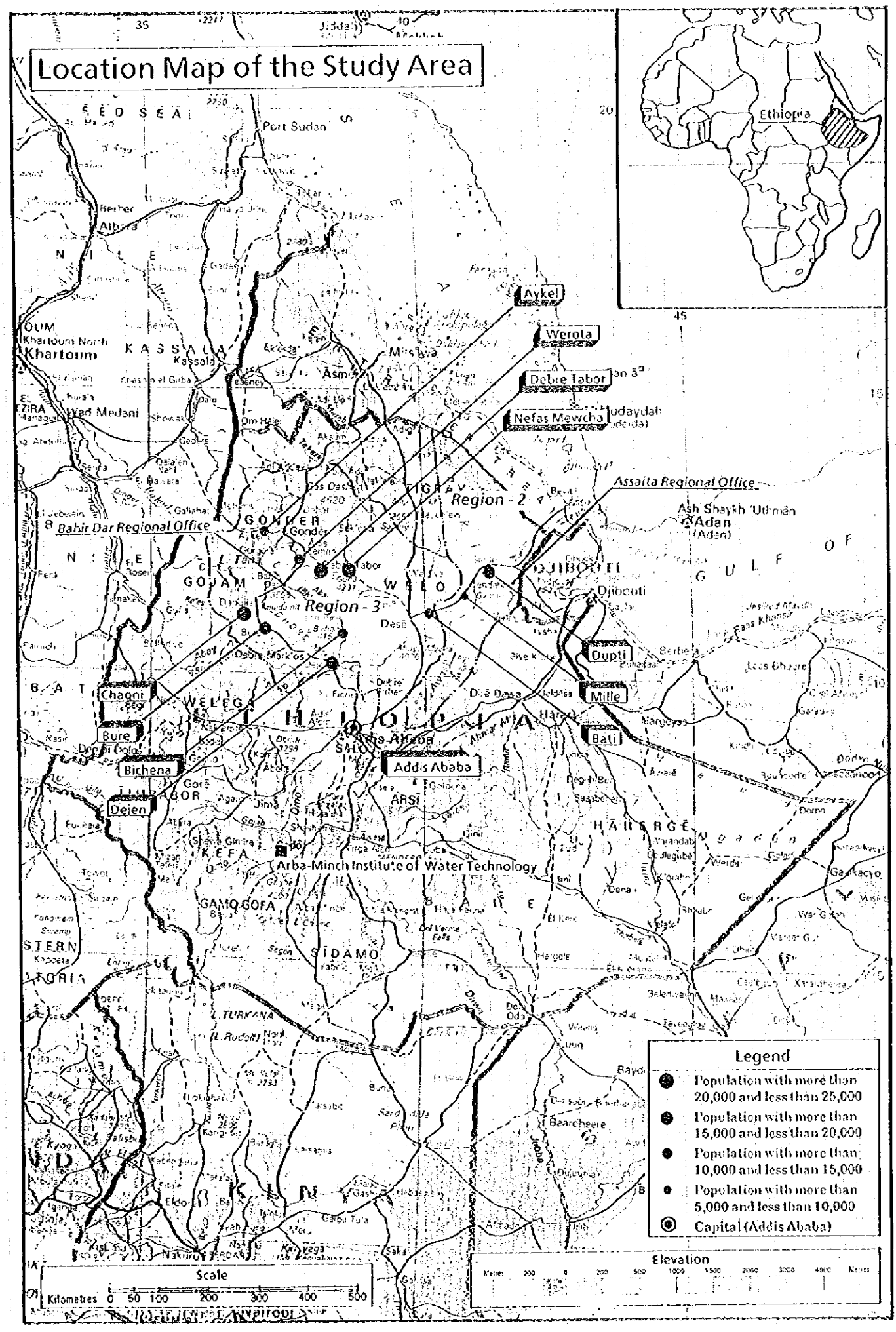
This report also incorporates the formulation of the Project of the water supply system with the implementation program, improvement plan of sanitary facilities with the diffusion program, set-up and strengthening of organization, and enhancement of operation and management.

The major objectives of this Study are: 1) to conduct a feasibility study on the water supply system in order to improve the 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 prevent the contamination of water source(s) and 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 Japanese fiscal year-period from 1994/95 to 1995/96 and divided into two 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 visits 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), construction of experimental toilets, sanitary education practice, current measurement in Bure, pumping test, and existing pump investigation.

The Study Team extends its heartiest thanks to WSSD especially these 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
Djibouti
Dupti
Mille
Bati
Chagni
Bure
Bichena
Dejen
Addis Ababa
Arba-Minch Institute of Water Technology
Port Sudan
Khartoum
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

Summary of the Project (Water Supply)

Center		Dupti	Mille	Bati	Werota	Aykel	D-Tabor	N-Mewcha	Chagni	Bure	Bichena	Dejen	Remarks
Population	1995	14,737	3,902	14,354	21,845	11,718	25,575	13,726	26,823	14,745	14,629	10,250	
Projected	2005	23,439	8,230	19,763	38,208	19,546	38,776	26,376	45,812	23,452	24,403	13,776	
	2010	28,517	11,543	22,360	48,764	24,258	46,054	35,297	55,737	28,533	30,411	15,586	
Water Demand	1995	192 (56)	130 (34)	400 (168)	276 (58)	31 (9)	106 (51)	93 (27)	291 (102)	200 (42)	101 (10)	131 (16)	( ) : Losses
in cum/day	2005	1,164 (140)	472 (57)	864 (104)	1,423 (171)	505 (61)	1,384 (166)	973 (117)	1,198 (144)	782 (92)	767 (92)	545 (65)	MDD : Max Day Demand
	MDD	1,746	708	1,037	1,708	606	1,661	1,168	1,438	938	920	654	PD : Peak Demand (cum/hr)
	PD	116	59	69	114	40	111	78	96	63	61	44	
	2010	2,222 (333)	853 (128)	1,247 (187)	2,369 (355)	893 (134)	2,293 (344)	1,652 (248)	1,966 (295)	1,254 (188)	1,427 (214)	839 (126)	
Service	1995	45%	97%	87%	94%	71%	34%	93%	46%	83%	67%	83%	( ): Achieved by both WSS
Coverage	2005	88%	100%	93%	100%	82%	66%	99%	69%	93%	81%	93%	& others.
by WSS	2010	100%	100%	95% (100)	100%	85% (100)	75% (100)	100%	75% (100)	95% (100)	85% (100)	95% (100)	
Proposed	HC	3.26birr/m³	3.03birr/m³	3.06birr/m³	3.01birr/m³	3.15birr/m³	3.67birr/m³	3.50birr/m³	2.93birr/m³	3.00birr/m³	3.43birr/m³	3.00birr/m³	HC: Household Connection *1
Water	YC	2.03birr/m³	1.80birr/m³	1.94birr/m³	2.25birr/m³	2.45birr/m³	2.23birr/m³	2.31birr/m³	2.14birr/m³	2.07birr/m³	2.31birr/m³	2.16birr/m³	YC: Yard Connection
Tariff	PF	1.51birr/m³	0.89birr/m³	1.05birr/m³	1.04birr/m³	1.11birr/m³	1.66birr/m³	0.82birr/m³	1.33birr/m³	0.76birr/m³	1.48birr/m³	1.06birr/m³	PF: Public Fountain
Well	Existing	4 (2)* 2	2	4	1	Spring×1	2	1	1	Spring×2	2	1	( ): Total Depth
	Deep 2005	Shallow wells 2 (37m)	2 (152m)	3 (414m)	4 (316m)	2 (140m)	6 (626m)	4 (400m)	5 (406m)	3 (248m)	2 (190m)	2 (178m)	
	Deep 2010	Shallow wells 2(33m)	1 (104m)	1 (114m)	2 (188m)	2 (101m)	4 (408m)	3 (310m)	3 (256m)	*3	2 (192m)	2 (128m)	
Rising Main	φ200						0.25		1.68				
in km	φ150	2.10		0.90	3.52	4.90	8.96	3.72	3.61	1.60	2.70 0.92	0.90	
2005 | 2010	φ100	0.50 1.00	3.54	2.13	1.00 0.75	2.50	3.23	0.69 2.30	2.39 2.06	3.17 1.90	4.07 0.92	2.31	
	φ75	0.80	0.50 0.95	2.00	0.35	3.20	3.50	1.59	0.46 0.20	4.93 2.30	0.72	8.43	
	φ50						1.10	3.40					
Booster Pump of Rising Main in 2005				φ=150mm Q=0.72m³/min H=80m	φ=150mm Q=0.76m³/min H=80m	φ=150mm Q=0.42m³/min H=225m	φ=150mm Q=0.43m³/min H=100m	φ=150mm Q=0.59m³/min H=100m	φ=150mm Q=1.00m³/min H=70m	φ=100mm Q=0.66m³/min H=90m	φ=100mm Q=0.32m³/min H=70m	φ=150mm Q=0.46m³/min H=120m	
					φ=150mm Q=0.43m³/min H=80m	φ=100mm Q=0.42m³/min H=225m	φ=150mm Q=1.03m³/min H=70m	φ=75mm Q=0.23m³/min H=100m			φ=100mm Q=0.32m³/min H=70m		
							φ=150mm Q=0.17m³/min H=70m						
Existing Reservoir		3m³ * 4 +20m³	3m³ ×2* 4 +20m³	45m³ * 4 +50m³	100m³*	42m³	70m³	70m³	70m³	150m³	100m³	50m³	
Necessary Reservoir		388m³	157m³	288m³	474m³	168m³	461m³	324m³	399m³	260m³	256m³	182m³	
Proposed Reservoir in 2005/2010		360m³ (180×2)	140m³ (70×2)	240m³ (120×2)	480m³ (240×2)	130m³ (65×2)	400m³ (200×2)	260m³ (130×2)	330m³ (165×2)	110m³ (55×2)	160m³ (80×2)	140m³ (70×2)	

Note: *1 Water tariff of industry & institution is same as HC's.
*2 2 wells working.
*3 Detailed survey to be required.
*4 Replacement

Center		Dupti	Mille	Bati	Werota	Aykel	D-Tabor	N-Mewcha	Chagni	Bure	Bichena	Dejen	Remarks
Distribution	ϕ300	350			445		315						
Pipeline	ϕ250				640		190	300	760				
in meter	ϕ200	515		285	430	285	750	378		620	320	335	
	ϕ150	1,295	7,040	1,305	1,980	4,005	5,680	3,005	3,785	3,040	3,825	2,830	
	ϕ100	650		740									
	ϕ75	4,410	520	5,300	4,178	1,050	8,580	2,635	7,230	4,220	5,105	2,475	
	ϕ50	10,576	1,560	6,330	9,545	7,300	16,310	10,800	7,670	4,290	13,050	9,035	
Booster Pump of Distribution Pipeline		ϕ=300mm Q=2.0m³/min H=34.0m	ϕ=150mm Q= 0.5m³/min ×2set H=12.5m	ϕ=75mm Q=0.1m³/min H=14.0m	ϕ=300mm Q=1.9m³/min H=20.0m	ϕ=200mm Q=0.7m³/min H=13.0m	ϕ=300mm Q=1.9m³/min H=17.0m	ϕ=250mm Q=1.3m³/min H=15.0m	ϕ=200mm Q=1.6m³/min H=9.0m	ϕ=200mm Q=1.1m³/min H=7.0m	ϕ=200mm Q=1.1m³/min H=13.0m	ϕ=200mm Q=0.8m³/min H=15.0m	
								ϕ=150mm Q=0.1m³/min H=23.0m		ϕ=150mm Q=1.1m³/min H=46.0m			
										ϕ=75mm Q=0.1m³/min H=59.0m			
Pressure Reduce Valve				4	4		10	5		2	3		
Additional Public Fountain		9	6	2	5	6	8	2	6	3	10	5	
Project Cost		14,889,898	9,115,314	14,970,913	19,390,479	18,102,997	27,244,807	19,081,551	19,942,733	15,810,837	15,344,661	12,924,824	Vehicles & Equipment
Supporting Work		3,734,097	1,327,780	1,549,729	3,371,258	1,375,352	3,431,127	2,134,578	3,179,393	3,752,516	1,426,279	1,032,259	14,794,508 Birr
Price Escalation		1,117,440	626,586	991,238	1,365,704	1,168,701	1,840,556	1,267,968	1,046,962	1,173,801	1,006,256	837,425	
Total (Birr)		19,741,435	11,069,680	17,511,880	24,127,441	19,271,698	32,516,490	22,489,097	24,169,088	20,737,154	17,777,196	14,794,508	

Composition of the Report

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

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

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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.

Under the above situation, the Government of Ethiopia (GOE) has given priority on the Eleven Centers Water Supply and Sanitation among the 230 rural centers listed under the National Development Plan (ERRP 1993-95). The Eleven Centers are Dupti, Mille, Bati, Nefas Mewcha, Debre Tabor, Werota, Aykel, Chagni, Bure, Bichena and Dejen as shown on the attached Location Map. Of these centers, Dupti and Mille are located in Afar Region (former Region-2), and the others in Amhara Region (former Region-3).

1.2 Overall Progress of the Study

This Study had been conducted over a two Japanese fiscal year-period from 1994/95 to 1995/96 and divided into two phases. The Phase I study had been carried out from January, 1995 to March, 1995, while Phase II study started in the following May and completed in February, 1996. During phase I study, a detailed survey had been carried out for Dupti, Mille, Bati and Werota, while the remaining centers in Phase II.

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, and initial environmental examination (IEE) and environmental impact assessment (EIA).

During second field survey in Phase II, experimental toilets were constructed, and sanitary education practice, current measurement, pumping test and existing pump investigation had been executed in addition to these items and activities mentioned above.

With the completion of the aforementioned surveys in Ethiopia, an interim report was presented to WSSD, containing comprehensive evaluation and understanding of present situation, concept and basic strategy of the Project. Based on the discussion with WSSD regarding the interim report, the Project plan has been formulated in detail during the home works in Japan.

1.3 Related On-Going and Programmed Projects

Following 10 on-going and programmed water supply and sanitation projects were identified by the Planning & Programming Department, Water Supply and Sewerage Agency. The external financing organs are IBRD, ADB, ADF, KFW, ORET, and so on, and their project costs range from about 2.5 to 340 million birr with benefited population of about 24,000 to 550,000.

- Twenty-five Town Water Supply Feasibility Study
- Twelve Towns Water Supply Feasibility Study & Design
- Three Towns Water Supply Feasibility Study
- Twelve Towns Water Supply Expansion & Rehabilitation Project
- Two Towns Water Supply Project
- Ghimbi & Woldia Water Supply Project
- Seven Towns Water Supply Project
- Three Towns Water Supply Project
- Adwa Water Supply Project
- Axum & Lalibela Water Supply Project

1.4 Overall Water Supply and Sanitation Conditions

The status of the water supply and sanitation sector is poor. Most of the population, urban and rural alike, do not have adequate and safe access to potable water supplies or sanitation facilities. Women and young girls are overly burdened within the sector, as they are the main suppliers and users of domestic water, and therefore remain the most susceptible to water-related illnesses. In general, over 70% of diseases in the country are believed to be water-borne diseases.

Existing data indicate that the overall coverage of water supply is 26% only. Further analysis of the coverage indicates that out of the total estimated 47 million rural population only 9 million or 18% have access to safe drinking water through an estimated 6,000 different rural water supply schemes. The water supply coverage in urban areas, where some 10% of the population live, is relatively better with about 76% of them supplied with potable water. Major problems in the urban water supply services include, low production levels, inadequate distribution systems and leakage in many places, estimated to be more than 30% of the water passing through the distribution network.

Sanitation has not been a priority sector in Ethiopia. The majority of people living in rural centers generally dispose off their body wastes in open-fields and in traditional pit latrines.

In practically all centers, dry solid wastes and sullages are generally dumped anywhere along the streets and in open spaces available. These situation take place environmental and health hazards. Because of blockages of drainage facilities in some region and non-existence of the same in other regions, stagnations of water and ponds that have been created, have become breeding places for mosquitoes and other flies.

1.5 Overall Social Situation

In 1993 Ethiopia's estimated population (excluding Eritrea) was 53 million, differing in ethnicity and religion. Ethiopians are a highly diverse nationality. The population and housing census of 1988-1991 identified 92 ethnic groups, the two largest being the Oromo (29%) and the Amhara (28%).

Many of the groups have intermarried and some are therefore strictly neither one ethnic group or another. Religion is not linked with ethnicity, for instance Oromo and Amhara people may practice either Christianity or Islam. The majority of Ethiopians are Christian (60.5%), Muslims accounting for 33% of the population and indigenous religions for 5.8%.

There are smaller administrative units as each region is divided into Zones, Woredas and numerous Kebeles. Each level of administration exercises it's own political power and legal personality.

Ethiopia is predominantly rural, with 80% of the population living in rural areas and relying on subsistence farming. The population has a high growth rate (3.1% per annum) with nearly half of the population under 15 years.

1.6 Overall Economic Situation

The gross domestic product of Ethiopia was 24,536.6 million birr in 1992/1993. The mid-year national population in the same year is estimated at 52.4 million. Therefore, per capita GDP is calculated at 468.3 birr. It is converted to 110 U.S. dollars with the exchange rate of 4.26 birr to one dollar.

The primary sector occupied the predominant position of 53.8% in the total GDP. Agriculture accounted for 86.9% of this sectoral GDP. During the nine year period from 1983/1984 to 1992/1993, this sector grew at the average annual rate of 2.1% which is at the parallel pace with the whole economy.

Summing up the above, it can be said that Ethiopia is a predominantly agricultural economy and the government has been trying to keep that way. The GDP deflator rose at the average annual rate of 8.3% during the nine years period mentioned above.

Chapter 2 General Description of the Study Area

2.1 Natural Condition

Among the Eleven Centers, nine in the Amhara Region, Bati, Aykel, Nefas Mewcha, Chagni, Dejen, Bure, Bichena, Debre Tabor and Werota, are located in the Western Highlands, and other two centers in the Afar Region, Dupti and Mille, are located in the Rift Valley.

The Amhara Region area roughly occupy the northern part of the Western Highlands and consists of massifs and plateaus with an average height of 2,000-2,500 m which are separated by the deep, steep-sided valleys of the major rivers. This area slopes gradually to the west and terminates in the extended lowlands. All of the nine centers were stretched on such plateaus or top of hills.

The Rift Valley involving the Amhara Region is rather narrow in the south, but in the northeast, it funnels out in the Afar plain. The Afar Region area is widely dominated by the Afar plain which mainly consists of large plains with low altitudes (300-700 m). In the northern and central plain, prominent depression features as the Danakil depression, Tendaho graben etc. are formed by the tectonic movement and subsidence, especially in Dalol-Asele district, the land falls to about 100 m below sea level. Mille and Dupti are located in the Tendaho graben area.

The climate in Ethiopia is broadly classified into three major climatic regions; namely, tropical climate, arid and semi-arid climate, and warm and cool highland climate. The nine centers in Amhara Region with elevation more than 1,750 m.asl and the two in Afar Region with elevation less than 500 m.asl, therefore, fall under the Warm and Cool Highland Climate and Arid Climate respectively.

2.2 Social and Gender Situation

Afar Region has a strong Muslim influence which determines the societal roles. The Region is predominated by an ethnic group of Afar. Afar traditionally are nomadic pastoralists inhabiting the arid lowlands of Eastern Ethiopia. Their nomadic lifestyle is determined by the harsh climate, low unreliable rainfall, high temperatures and low levels of surface water. Many Ethiopian highland groups (including Amhara) have moved to the urban settlements in the region and are involved in trade and activities like laboring on plantations. A lack of understanding exists between these settlers and nomads because of the vastly different lifestyles and cultures.

Amhara predominates the Central and Northern highlands including Amhara Region. Peasants, mainly Christian in the West and mainly Muslim in the East, live in scattered homesteads located on land they work or own with their wives and children. Sometimes villages are formed by a number of married brothers and other kin including older parents. Amhara readily settle in larger villages and towns.

Poor quality of water, sanitation and a lack of adequate health services contribute to the high infant and maternal morbidity and high mortality in the regions. Socio-cultural beliefs and practices reinforce their dependent position in the household and society. This also leaves them without decision-making power. Traditional women's associations are not well developed and misuse of women's cooperatives have helped to build up a deep-rooted dislike of associations by women. Full participation of women thus requires a careful approach (Lukach Haile, 1993).

In male headed households women are primarily responsible for domestic activities and secondarily involved with trading. About half of the households in the Study Centers were headed by women (46% of households in household survey). These women are responsible for the male and female roles of a male headed household, with no opportunity to divide the labor. These women have control of resources and the responsibility of generating resources to support their families.

2.3 Economic Situation

The average annual population growth rate from 1984 to 1993/1994 for the Eleven Center is calculated at 5.9%. It is about twice high compared to the national average. Demographic concentration to urban centers is evident from it. The growth rate was the highest in Mille with 8.80% and the lowest in Dejen with 3.21%.

Major occupations are commerce (about 50%), day labor (about 20%), governmental service (about 15%) and others such as agriculture, animal husbandry, cottage industry and so forth (about 15%).

The average monthly household income of the Eleven Centers is calculated at 259 birr. Dupti has the highest income with 334 birr, while the income in Aykel is the lowest with 182 birr. About 50% of households earn less than 200 birr per month. Engel's coefficient, which is the percentage of the expenditures for food and drinks out of the total household expenditures is 66.6% on average.

The household income per day works out to 8.6 birr on average. The average family size across the Eleven Centers comes to 5.9 persons. It means that the average household income per day per capita is 1.5 birr.

2.4 Town Planning and Power Supply

Regarding the master plan for town planning and the topographic maps for Eleven Centers, they were collected by the Team except for Mille and Dupti centers, which were formulated during the era of the Imperial Government. These existing master plans for the nine centers are still being applied to date, while the master plan for Mille and Dupti are not formulated at present and reportedly there is no schedule to formulate the plans in near future.

Based on the present situation, existing hydroelectric power is employed as the power source for the water supply in such centers Bati, Debre Tabor, Werota, Bichena and Bure. Those Centers, which are scheduled to have hydroelectric power in specified near future, such as Dupti, Aykel, Nefas Mewcha, and Dejen shall have the hydropower as the source of the water supply by the time the Project will have been completed since operation cost for hydropower could be about half to 60 % of that of diesel generated power.

Chapter 3 Comprehensive Evaluation and Proposed Measures Based on Present Situation

3.1 Water Resources

The existing water sources in Eleven Centers are divided into tow; namely, groundwater and spring. Centers in Afar Region are located in the Rift Valley and those in Amhara Region are located in the Abisinian plateau. Mean annual precipitation varies from 200 mm to 300 mm with Dupti and Mile in the Rift Valley and it varies from 800 mm to 1,700 mm with the centers located in the Abisinian plateau.

Most of the precipitation is concentrated in the rainy season (June - September) called Kerempt. Recharge to the groundwater aquifer occurs only in the rainy season mostly in July and August. The Dupti area is an exception. In the area, since the sand and gravel aquifer is confined by the impervious clay layer, recharge does not occur in the area. Therefore, the aquifer has high concentration of salinity. In Dupti, shallow wells will be planned to develop the seepage water from Awash river.

Because of very small water watershed area per well in Debre Tabor and Nefas Mewcha (0.5 - 3 km2), over-pumping is a serious problem, which causes lowering of the static water level in the late dry season (April - June) every year. Similar cases also occur with springs. In Aykel, the yield of the spring (source of the water supply) becomes smaller in the late dry season every year and dried up in the end of dry season this year (June, 1995).

Followings are the proposed new sources for the Project:

- Deep wells	;	Mille, Aykel, Werota, Debre Tabor, Nefas Mewcha, Chagni, Bichena, Dejen, Bati
- Shallow wells + Deep wells	;	Dupti (Deep well: existing)
- Springs + Deep wells	;	Bure (Spring: existing)

3.2 Water Quality

In terms of physico-chemical aspects, all samples, which had been collected from the sources of WSS or Water Committee, showed that the analyzed constituents were within the acceptable range in accordance with the WHO guideline, with exception of Dupti's.

In Dupti, there are two WSS boreholes which are serving as the source, those of which show that such constituents as sodium, iron, chloride and fluoride are above WHO guideline values. Also, sulfate detected in three samples collected from Russian camp, Tendaho plantation and RRC are above the guideline value. Among the constituents above WHO guideline, the effect of fluoride is the most serious with the fact that between 40 to 50% of children had been found with mottling of their teeth in physical observation carried out in February 1995.

In terms of bacteriological aspect, a couple of samples from the sources of WSS or Water Committee showed faecal coliform contamination, those of which are in Dupti, Mille, Bati and Aykel. The numbers of the coliforms per 100 ml are 2 for Dupti, 1 and 3 each for

Mille's two boreholes respectively, and 3 for Bati Borehole No.1, while the source of Aykel is found to be severely contaminated with too-many-to-count faecal coliforms.

It is probable that the distribution water can be easily contaminated through cross-connections, leaking and infiltration based on the result that samples collected from the outlets of water supply system such as house connection, yard connection and public fountain have been found contaminated with several to fairly number of faecal coliforms even if the source is free from faecal contamination.

Samples collected from household container had been found with more contamination of faecal coliform than water supply system. Specially clay pot, which is the most popular container for water strafe, showed too-many-to-count faecal coliforms in many cases. Since clay pot has porous portion in its shell, there may be high possibility that coliforms could develop easily through improper handling of the container associated with poor awareness of sanitation of the consumers.

3.3 Water Collection, Consumption and Demand

Regarding the service mode, water users in Ethiopia are divided into the following five modes with reference to the existing situation.

- Household Connection Users (HC)
- Yard Connection Users (YC)
- Neighborhood Tap Users (NU)
- Public Fountain Users (PF)
- Traditional Source Users (TSU)

Household connection means the connection installed in household, while yard connection in yard outside household, both of which are categorized in private connection. Neighborhood tap users are the ones who do not have such private connection, thus depend on mostly neighbor's yard connection.

In most of the Eleven Centers, women and to lesser extent girls collect most of the water. In Dupti and Mille, men spend a significant amount of time collecting water from public fountains and other sources. Furthermore, in Aykel and Chagni, boys spend a time sharing water collection tasks with the women. Women and to a lesser extent girls undertake all of the other water related activities and are responsible for water management in the home. Generally women and girls are the primary target group with men being target groups in Mille, Dupti and boys being additional target groups in Aykel.

According to the data, Public Fountains are used by a slightly more female headed households than male headed household. There are more male headed households using Private Connections which implies that women household heads do not have such good access to these facilities. More women headed households use well water than male headed households, probably because once dug, well water is free or relatively cheap. A larger number of male headed households using vendors was expected as they are the most expensive sources of water. However this is probably counteracted by the ease of

collection from vendors which women probably prefer (despite the cost) because they do not have spare time to go to other sources.

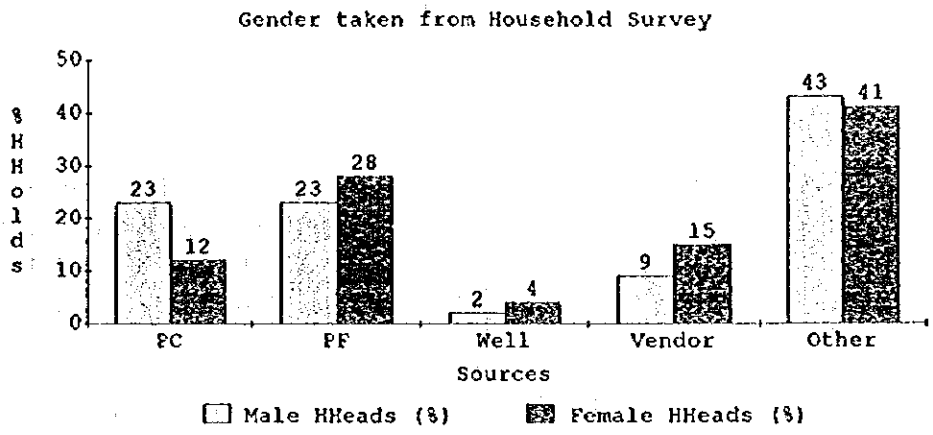


Figure 3.3.1 Water Sources Used by Households

According to the water consumption census and the data obtained at WSS offices in the Centers, the percentage of the population served ranges between 33% in Debre Tabor and 97% in Mile. In descending the percentage after Mille, the order is ranked with Werota (96%), Nefas Mewcha (93%), Bati (87%), Dejen (83%), Bure (83%), Aykel (71%), Bichena (67%), Chagni (46%), Dupti (45%) and Debre Tabor. The centers with low percentage reveal either shortage of piped water or probability of other sources such as spring and well people are depending.

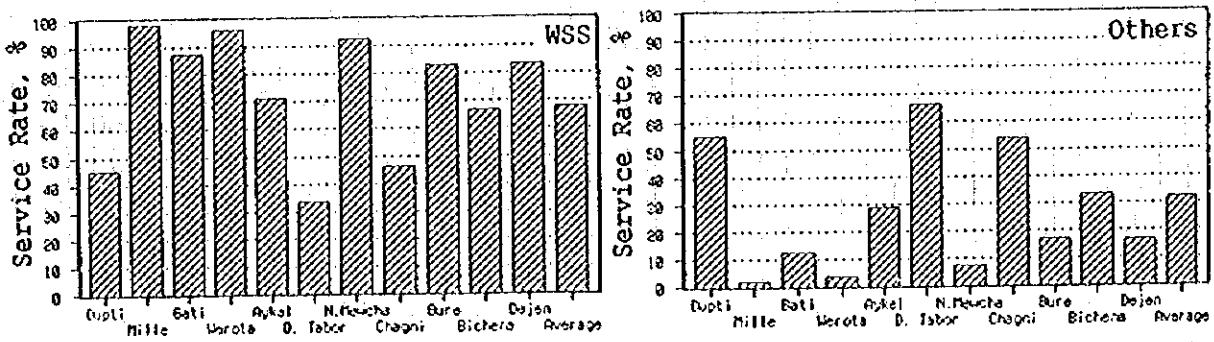


Figure 3.3.2 Comparison of Water Service Coverage among Eleven Centers

Water consumption and demand were identified by the water consumption and demand census survey, and they were summarized as follows;

- Demand always surpasses the actual consumption; namely, 46 lpcd of demand to 43 lpcd of consumption in case of household connection, 37 lpcd to 30 lpcd in case of yard connection, 30 lpcd to 11 lpcd in case of neighbor's connection and 23 lpcd to 4 lpcd in case of public fountain in the Eleven Center's average.

- The difference between consumption and demand becomes the most in case of public fountain users. This is probably because the public fountain users have difficulty to fetch water more than three times a day from the practical point of view despite their demand.

3.4 Water Supply Facilities

The number of existing boreholes is scarce to meet the water demand of the population, therefore the water supply can be suspended easily where there is only one borehole or only one generator equipped. Those wells' construction standard is so low that it is difficult to measure static/dynamic water level. There is no borehole equipped with a complete set of air pressure gauge and flow meter,

Existing water supply system is operated by either hydroelectric power or on-site generator. Centers, where the water supply system is operated by on-site-generator, don't have standby generator, thus operation hours of the generators are limited due to the cooling. Even in the Center where the water supply system is operated by hydroelectric power, the existing electric facility is insufficient in terms of the capacity, thus the submersible pump can not work with the full specification.

Although most of the pipeline are branched system with galvanized steel pipes, in some centers, existing rising main has the functions of both transmission and distribution. Operation valves are usually fully opened, so the reservoirs do not function on the initial purpose. The capacity of the service reservoirs is insufficient to store water against the current demand which has been enlarged due to population growth.

Daily routine works such as switching on/off, valve operation are usually carried out by the staff stationed. Only minor maintenance such as the replacement of valves and meters is made by the staff. Maintenance work and other major works such as installation of pipes, generator,etc. are done by Water Supply Section of the Regional Office, who is not on time available. Although the inspection tour is carried out by O&M crew in the Regional Office once a year, no regular check-up for the existing facilities has been made.

In order to secure stable and safe water supply, measures shall be taken, those of which are 1) rehabilitation of the existing boreholes with replacement of aged existing pumps, refinish of boreholes, and installation of necessary instrument such as flow meter and air pressure valve, 2) replacement of existing reservoir to secure the necessary storage capacity for the demand, 3) construction of new rising main and extension of the existing distribution network, 4) set up of regular operation and maintenance system with support from Regional Office, and 5) securing the compatibility of spare part by purchasing the equipment from certain countries.

3.5 Sanitary Facilities Condition

The general observation is that the current sanitation condition is very bad in practically all centers. A majority of people use open field for excrete disposal in almost all centers.

The dry pit latrines, private, shared and public are not only few in number compared to the size of population, but they are also ill-maintained and neglected. When latrines are filled up (usually takes 2-3 years to be filled), the majority of the owners either construct new one if they have space or resort to open-field disposal of excreta, thereby increasing the trend of open defecation. Arrangement of vacuum track for emptying the filled latrines is very difficult and no sullage damping site is prepared in all Centers.

It has been observed that a very few of them have dumping sites prepared for disposing dry solid wastes. Most of them do not have any allocated sites reserved to dispose of refuse. From the household survey that has been carried out, all centers except for Dupti and Bati, dispose of more than 60% of their refuse anywhere wherever it is convenient for the people to dump.

Very few of centers have facilities for the drainage of rain water. The main streets in each center bisect the center. They have proper side and cross drainages for the main road. But these drainage ditches are not regularly and properly maintained. Other streets or roads within the municipalities of the centers have proper neither rain nor waste water drainage facilities.

In order to remedy the deficiencies and to improve the bad sanitary conditions prevailing, such measures are proposed, those of which are 1) to introduce toilet facilities with simple physical features which can be copied by the users, and design the toilet with full use of local materials, which can be constructed by the users, 2) to employ or get the users/communities involved into the construction stage so that they can be motivated or owner-sensed, 3) to establish maintenance system by the user with the supervision of WSS and municipality, 4) to provide vacuum tracks and refuse disposal trucks with essential number of bins, and prepare sludge dumping sites agreed with surrounding people, 5) to provide adequate and functional drainage facilities to prevent formation of water stagnations and water ponds, and rehabilitate and maintain the existing drainages.

3.6 Health and Sanitary Awareness

The level of health and sanitary awareness reported varies within the same center with the different survey methodologies but is generally high (see Figure 3.6.1). According to the household survey, the centers with the highest level of health awareness include Dupti, Aykel, Debre Tabor and Nefas Mewcha, while Chagni, Bure, Bichena and Dejen show the lowest levels. For almost all the centers except Bati, Chagni and Bure, knowledge about ORS is significantly lower than knowledge about diarrhea disease control. The incidence of diarrhea reported in the household survey is lowest in Bati and highest in Bichena and Chagni. This correlates weakly with the level of diarrhea disease control awareness (correlation coefficient (CC) 0.4).

Figure 3.6.2 shows the responses of the household survey to each sanitary behavior indicator. The three behaviors below the 25 % line are the use of piped water always and the sanitary disposal of solid waste and waste water. These sanitary behaviors are the poorest and are priorities for sanitary education. Those behaviors between 50% and 75% lines are also poor. They are hand-washing with soap after defecation and after handling

children's stools, fly control and sanitary disposal of children's excreta. These are also priority behaviors for the sanitary education program.

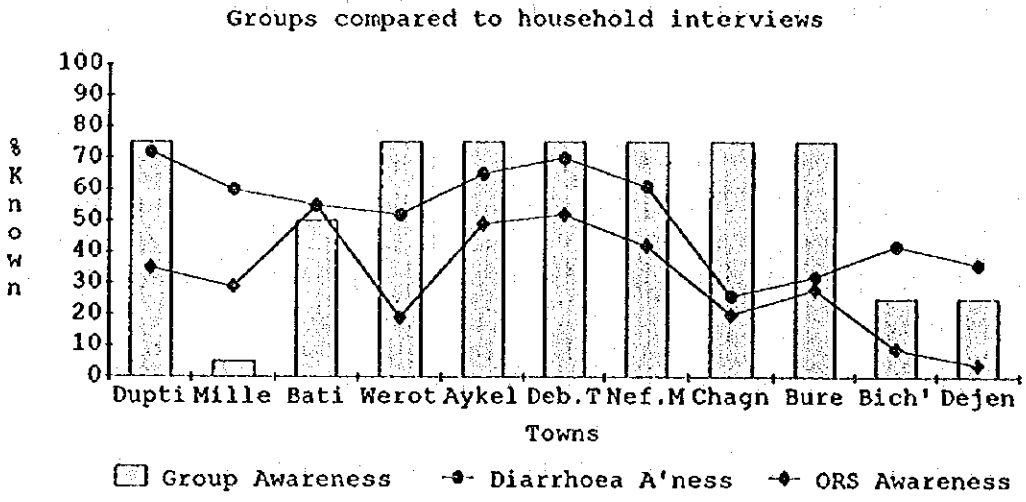
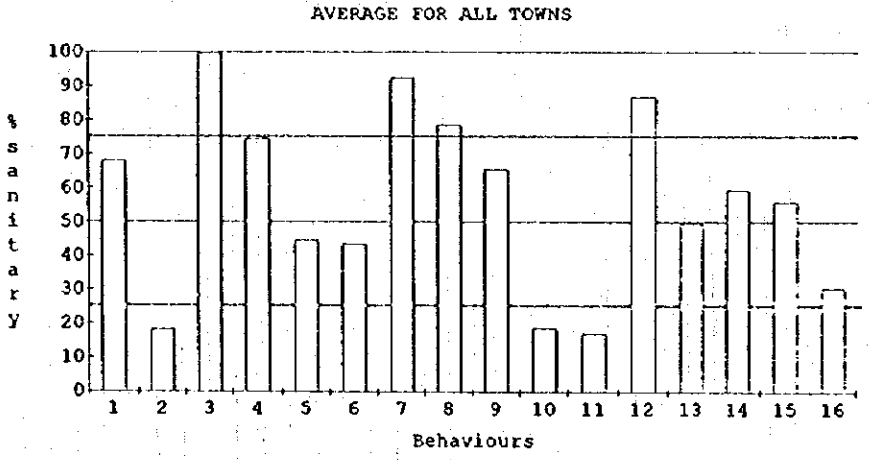


Figure 3.6.1 Levels of Health Awareness



No.	SANITARY BEHAVIOURS	SANITARY SCORE
1	Access to piped water	68
2	Use piped water supply always	18
3	Covered water container	100
4	Water scoop kept off the floor	74
5	Handwashing with soap after defecating	45
6	" after handling childrens stools*	43
7	Covering cooked food during storage	92
8	Not eating unwashed raw fruit and vegetables	79
9	Kitchen utensils stored off the floor	65
10	Rubbish burried or burned	19
11	Wastewater disposed in pit/drain/veg. garden	17
12	No animals kept in the house	87
13	Home not infested with flies	50
14	Latrine in use by household	59
15	Latrine in use by all household members	56
16	Infant's excreta disposed of in latrine*	30
TOTAL SCORE FOR SANITARY BEHAVIOURS		902

*As proportion of households with young children

Figure 3.6.2 Indicator Sanitary Behaviors

3.7 Organization and Management

The departments and services of water supply and sewerage services at central level are now under the Ministry of Water Resources(MWR) along with the departments and services of the former Water Resources Development Authority (WRDA).

Regarding regional organization of water supply and sewerage services, there is Water, Mine and Energy Bureau (Amhara Region) or Water Resources Bureau (Afar Region) under a regional government. Under the bureau, Water Supply Section, which is the organization corresponding to the former regional office of WSSA is established.

WSS is generally formed with Manager, O&M head, administrator, financial officer and technicians. In each center classified as urban, there is an office of WSS, and the personnel for the management and the maintenance is stationed. However, there is no WSS in the satellite towns of Dupti and Mille. The staff stationed in the satellite centers is generally consisting of an administrator, water meter readers, public fountain attendants and operators. The administrator is assigned from the WSS in the urban town, and the other staff is generally hired on a contract basis.

The activities and role of WSS must be enhanced on a drastic scale. To make it possible, there will arise the needs for ample supply of skilled labor. Also, such authority as decision-making on water tariff and employment/dismissal of WSS's employees, which are currently under the regional office, must be transferred to WSS subject to the Regional Office.

Female participation in the workforce in the water supply related organizations is estimated at around 20%. At the WSS level it is calculated at 27% on average for Eleven Centers. As females are more directly connected with water and sanitation in everyday life, it will be desirable for them to participate more in the workforce concerned.

3.8 Financial Condition

Most of WSS's in the Eleven Centers are financially in the red despite the fact that officials and workers concerned are individually doing their utmost in their daily work and operation. The roots of the problems are very clear: one is the shortage of absolute amount of water produced and another is low water price.

The objective of the water supply project under this Study is to provide a sufficient water to the people of the Eleven Centers, that is to say, to resolve the first problem. To resolve the second problem, two institutional measures are introduced; namely, progressive water tariff and double entry accounting system.

The concept behind the progressive water tariff is to set a minimal water price up to a life-line water consumption, and after that to raise unit water price progressively higher as consumption goes up. It is known that higher income households consume more water per capita. Through this system each household can purchase water at a price conforming

to its economic level. Big commerce and industry automatically pay higher water charge per unit consumption since they use more water.

Most of WSS's in Eleven Centers are financially in the red irrespective of the fact that they adopt the single entry accounting system. They do not incorporate investment cost in preparing financial statements. Such items as depreciation, payment of interest are not entered in the income statement. The consequence is that profit under the existing system may totally disappear under the double entry accounting system. To rectify such situation, the double entry accounting system is proposed. The system draws the real picture of financial status, whereby eventually making management more sustainable.

Chapter 4 Design Criteria of the Project

4.1 Water Resources Development

Groundwater of deep aquifers is the most ample water resource to be developed for water supply, since water is potable without treatment. In order to estimate the quantity of ground water, the safe yield concept is approximated in such a way that safe yield is limited to the quantity of recharge estimated in an average year. However in the Abisinian plateau, since watershed area for well is very small, this approximation cannot avoid over-pumping. For such watersheds, the criterion is newly adopted; namely, recharge in drought period (5 year in return period) is to be the maximum for the safe yield. This criterion is applied for Bati, Aykel, Debre Tabor, Nefas Mewcha, Bure, Bichena and Dejen.

In general, the low-water flow in an average year which is 355 day flow in probability is considered to be the minimum intake rate for the design of spring and surface water, while the average yield of rainy season is the maximum intake rate. The spring near Edget Behibret elementary school in Bure is an exception because the spring forms a pond gushing at the bottom. Since it is difficult to intake all the yield, the intake rate is to be reduced to 50 % of the criteria when the spring is adopted as the source.

In Bure, the yield of Spring No.1 was relatively stable even in dry seasons according to the production records. Therefore, it is decided for the spring to take average yield of the sprigs to be the minimum intake rate.

4.2 Population Projection

Regarding the 1995 population, it was basically estimated using the 1984 to 1993/1994 average annual growth rate. However, the Study Team has collected the 1994 population census figures for Bati, Werota, Aykel and Chagni although they are preliminary ones. The Team adopted them as the 1995 population. For Dupti WSSA estimates and for Mille water consumption census figures were adopted.

Regarding the projection of population from 1996 onward, it was done based on the average annual growth rate 1984 to 1993/1994 for all Eleven Centers. The population growth between 1974 and 1984 was also considered for the centers where such data are available. Further, socio-economic conditions for each of the towns were taken into account.

Table 4.2.1 Population Projection

Towns	1995	Growth Rate	2000	Growth Rate	2005	Growth Rate	2010
Dupti (WSSA)	14,737	5.0%	18,809	4.5%	23,439	4.0%	28,517
Mille (JC)	3,902	8.0%	5,733	7.5%	8,230	7.0%	11,543
Bati (PC)	14,354	3.5%	17,048	3.0%	19,763	2.5%	22,360
Werota (PC)	21,845	6.0%	29,234	5.5%	38,208	5.0%	48,764
Aykel (PC)	11,718	5.5%	15,315	5.0%	19,546	4.5%	24,258
Debre Tabor (CC)	25,575	4.5%	31,871	4.0%	38,776	3.5%	46,054
Nefas Mewcha (CC)	13,726	7.0%	19,251	6.5%	26,376	6.0%	35,297
Chagni (PC)	26,823	6.0%	35,895	5.0%	45,812	4.0%	55,737
Bure (CC)	14,745	5.0%	18,819	4.5%	23,452	4.0%	28,533
Bichena (CC)	14,629	5.5%	19,120	5.0%	24,403	4.5%	30,411
Dejen (CC)	10,250	3.0%	11,883	3.0%	13,776	2.5%	15,586

Notes : CSA = Forecast by Central Statistical Authority
Growth Rate = Annual average growth rate
PC = Population Census
CC = Cartographic Census
JC = JICA Census (Water Consumption Census)

4.3 Water Demand Projection

Taking current ratio of population piped-water-served into consideration, the target rates, ranging from 75% to 100%, are to be achieved at the target year of 2010. The target rates are to be ones achieved by WSSD water supply, and the remainders can be managed by individual wells and/springs which yield relatively clean water and are currently utilized. Water demand in each center is calculated by adding the three items; namely, 1) domestic demand, 2) non domestic demand and 3) uncounted losses.

Service mode of domestic supply is to be categorized in such three modes as 1) house connection, 2) yard connection and 3) public fountain. Although yard connection is subdivided into yard connection and neighborhood connection in Ethiopia, the neighborhood connection is accounted to be yard connection in this Study because the neighborhood connection is regarded as unexpected one which was introduced due to insufficient connections.

Based on water census survey, the current demand for each domestic service mode is summarized as follows. The typical demand by modes is to follow WSSA guideline values in this Study, and be adjusted with reference to the current consumption, climatic condition and time elapse after completion of the Project.

- The demand for household connection ranges 27 liter per capita per day (lpcd) to 83 lpcd and the average among Eleven Centers is 46 lpcd. The average is lower than that of WSSA guideline value 60 lpcd, probably because the demand may be conservative under situation of insufficient water.

- The demand for yard connection ranges from 20 lpcd to 52 lpcd, while the average is 35 lpcd which is almost same as WSSA guideline value.

- The demand for public fountain ranges 15 lpcd to 33 lpcd and the average is 23 lpcd. This average is higher than that of WSSA guideline value 15 lpcd. However, as long as water is fetched from public fountain, the supply per household member could not exceed 15 liter per day.

The percentage of population by service modes will also vary according to the time elapse after completion of the Project. The percentage composition at year 2010 is estimated based on payable amount corresponding to each service mode, and the composition is to vary progressively from the current situation.

Non domestic demands is categorized into three such as institutional, commercial and industrial. Based on the unit demands recommended by WSSA guideline, institutional demand is projected with the population growth rate, and commercial and industrial demands are projected with economic growth rate which is to be the population growth rate plus three percent.

Uncounted losses are generally composed of leakage, illegal use and flushing use. The losses at the years of completion of the Project and 2010 are proposed at 10% and 15% of the total water demand respectively.

Water consumption through a year varies from day to day. The maximum day demand is the highest demand in a day of specific year. The data concerned with the maximum day demand is not recorded in any WSS office, therefore the factor of 1.5 is proposed in Mille and Dupti and the factor of 1.2 in the remaining centers taking into consideration climatic condition.

Fire demand for fire fighting is provided as a reserve of 10% of the service reservoir.

4.4 Water Supply System

Utilization of the existing facilities in the Eleven Centers is firstly proposed in order to reduce the initial project cost. The utilization criteria shall be based on the following factors:

- Age and condition of the existing facilities,
- Capacity of the existing facilities, and
- Compatibility of the existing facilities.

Hydroelectricity is utilized as the power source of water supply facilities in such centers where hydropower is available, and also standby generator is to be provided for the emergency case. In other centers where hydropower is not available, on-site generator will be adopted, and standby generator will be supplemented in Mille and Chagni which are not specifically scheduled for being extended hydroelectricity.

Groundwater is to be developed stage by stage corresponding to the two target years of 2005 and 2010, while intake facility for surface water and spring will be designed for the maximum day demand of the Year 2010.

The following water supply facilities will be provided in the Project;

- Intake facility
- Spring collection chamber
- Pumping Station (with generator)
- Disinfection system
- Rising Main
- Distribution System
- Pipelines
- Reservoirs
- Public Fountain
- Fire Hydrants
- Controls and Metering

4.5 Drainage and Sewerage Projections

In line with the improvement of water supply, waste water is expected to be increased. With generation rate of 60% to 70%, the estimated waste water is not large in the volume, ranging from about 200 m^3 to 900 m^3 per day in year 2005 and from about 500 m^3 to 1500 m^3 per day in year 2010 per center.

Based on the projected waste water volume, conventional sewerage system is not required to all Eleven Centers other than drainage facilities accompanied with waste water disposal pit (sullage disposal pit). This drainage also works for the purpose of draining rain water and keeping free from stagnant water.

Chapter 5 Improvement of Health and Sanitation

Experimental practices had been carried out in order to facilitate the formulation of this Project, those of which are:

- Construction of experimental toilet,
- Practice of sanitary education, and
- Practice of emptying toilet.

The experimental practice identified the hindrance and blockade for the community regarding sanitation improvement, and clarified the measures which must be taken into the formulation of the Project.

5.1 Improvement of Sanitary Facilities

In almost all the centers the people mostly use, at present, open defecation and traditional pit latrines. Since the use of traditional pit latrines is going to be frequent now and in the immediate future, the present defects have to be firstly improved with proper lining (branches, stone, adobe, etc), wider holes, strong flooring, constant maintenance and up-keep. Also, such toilet facilities agreeable to the population must be introduced; namely, simple design which can be copied easily by the users, utilization of local material and so on.

Toilets are usually filled up in two to three years, therefore arrangement of vacuum track for emptying the filled ones should be made with adequately prepared sullage dumping site.

Waste water comes out from the house due to bathing, laundry, preparation of food, cooking, washing of dishes and utensils in the kitchen, and other personal and domestic activities. Waste water disposal pit needs to be prepared in households, hotels, restaurants, bars, tej and tella houses, health center, clinics, etc. The soakaway pits, should be lined with open-joints until it is about 30 cm below the ground where it should be pointed.

At present, there are few solid waste disposal sites. Strategical sites should be allocated at the outskirts of the center for dumping. The dumping site should be prepared in the from of a "depression" or similar to that of a stock pond. Each household should have a container with a lid to collect the refuse or put its refuse in a nearby bin provided by the Municipality. The collected refuse should be transported to the dumping site by refuse disposal truck or by animal drawn cart. The dumped refuse should be burnt as frequently as the need arises.

The main roads have properly constructed side as well as cross drainage facilities. But town rubbishes and other waste materials have blocked most of them, and the drainage facilities are not functioning the work they are constructed for. Consequently the blockages cause water to stagnate and in some cases causing floods. Those blocked drainage facilities have to be opened up and kept up the maintenance to have the facilities always work.

The parallel streets to the main road and the side streets should have drainage ditches install in them either by road equipment or by labor intensive method to avoid formation of stagnant water.

5.2 Sanitary Education and Implementation Program

The Ministry of Health has overall responsibility for health including sanitary education. They have a cadre of trained sanitarians based in most of the towns in the Eleven Centers. Thus any sanitary education activities relating to WSSA and WSSs should be carried out in close coordination with these sanitarians. There are four major areas where sanitary education can be encouraged by building on the interests of other existing local structures; namely, health centers, schools, religious institutions and health committees. They will be a more sustainable option than creating a new sanitary-related-cadre.

In order to support sanitary education approach, a manual and video titled "Simple Steps...for Better Health" have been prepared during this Study in both English and local languages. The manual contains tools and methodologies to encourage people to build on their existing health knowledge, motivating them to find out more and to lower the health risks they expose themselves to by improving their sanitary behaviors. The manual and the video can be used by Community Participation Promoter (CPP), Regional Offices and WSSs in coordination with Ministry of Health staff, and science teachers for use with schools during health classes and Health and Anti-Aids Clubs.

A responsible person is required at each center at least in the short term to provide the momentum to get systems operating in an effective manner. This role is proposed to be filled by experienced CPPs dispatched from Regional Offices in coordination with the center's WSS. The CPPs should work in such a manner that when their support for the Project stops, then the sanitary education program continues. To facilitate their works, a CPP supervisor should be assigned from the central WSSD. The supervisor is expected to be one who was assigned to this Study since he/she is already familiar to such work.

Chapter 6 Reinforcement of Organization

6.1 Reinforcement of Concerned Organization

In light of the fact that whether people of the country can enjoy a reasonable level of water supply or not depends on the good and far-sighted planning of MWR, it is proposed that planning functions be strengthened and reinforced. Under the new organizational set-up of MWR, Planning and Project Department appears to perform planning functions. The department is currently composed of Planning & Evaluation Team and Project & Policy Study & Evaluation Team. It is newly proposed that the department have four divisions; namely, 1) Demand Projection and Facility Planning Division, 2) Financial Planning Division, 3) Personnel Planning Division and 4) Monitoring & Evaluation Division.

Under the existing regional organizational set-up, Water Supply Section provides technical, personnel, financial, equipment & supply, operation & maintenance and water supply services to WSS's concerned. The Section is now under Water, Mine and Energy Bureau or Water Resources Bureau of the Regions. It is proposed that the relationship between the Water Supply Section and WSSD be strengthened in some way or another (institutionally or otherwise) because the regional government may sometimes face limitations/constraints in terms of technology, manpower, finance and information for matters of water supply and sanitation.

WSS is the executing body of the daily water supply services to the population and commerce/industry in a center. The WSS organization shall be strengthened taking into consideration the current vicious situation of finance and management resources. The proposed organizational set-up of WSS is shown in Figure 6.1.1. There will be four services under Manager of WSS; namely Administration, Financial, Technical and Sanitary Services, with Internal Audit and Customer Services. The proposed is an ultimate and exemplary one to be realized in the target years of 2005/2010, and the actual organization will gradually expand starting from the existing one.

WSS will be renamed Water Supply and Sanitation Service (abbreviation will be the same), because it will be additionally in charge of sanitation-related services which is dealt by the Sanitary Service. The task of the Service is 1) to provide information and public relations services to help people to get involved in sanitary activities and to install toilet facilities, 2) to provide loan/subsidy to clients for the installation of septic tank toilets, 3) to keep the related records, 4) to prepare vacuum trucks to regularly empty toilets, and 5) to clean and maintain drainages regularly.

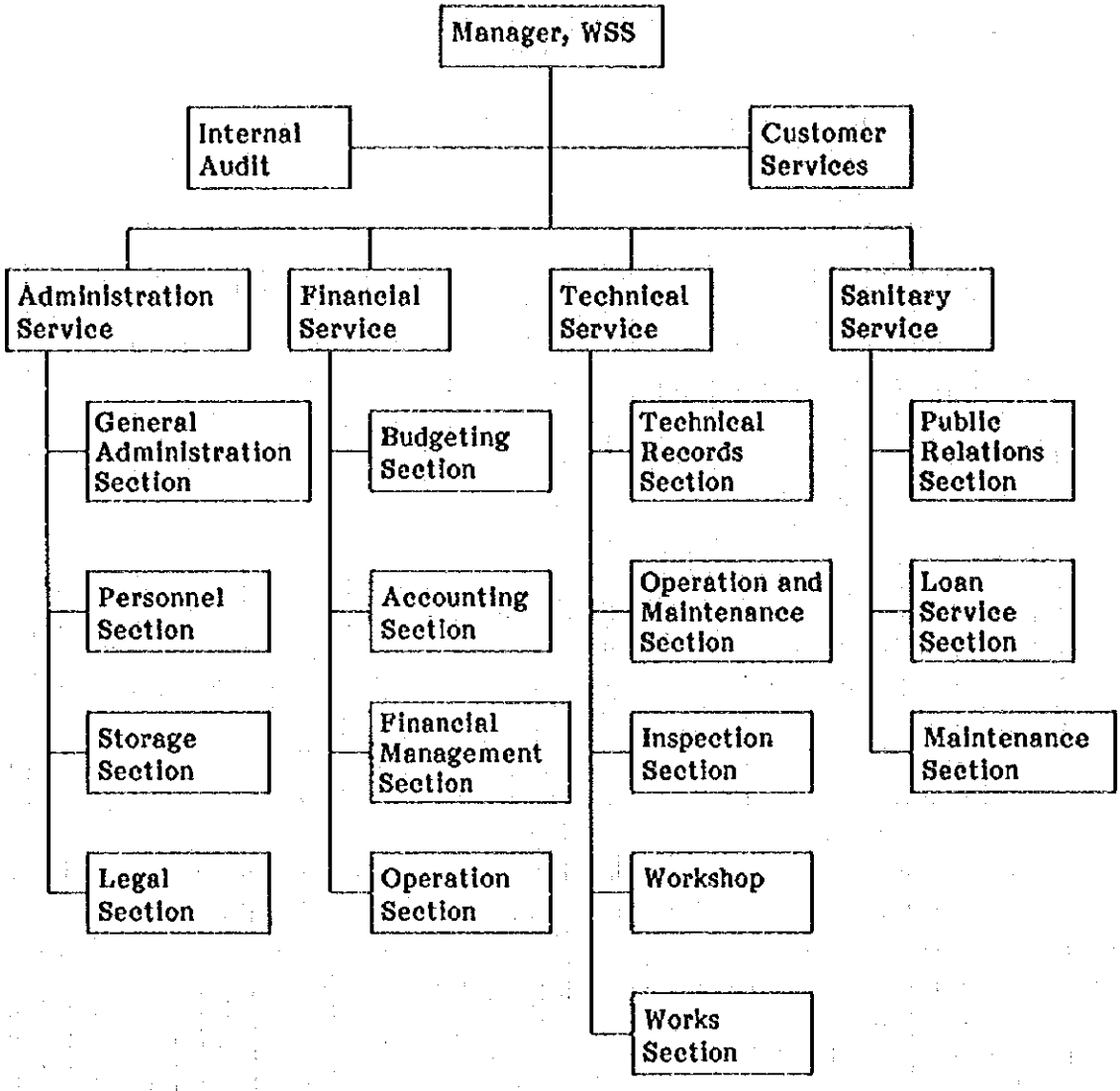


Figure 6.1.1 Proposed Model Organization Set-up of WSS

6.2 Sanitary/Health Committee

A committee related to sanitation is newly required to improve sanitary condition, promote sanitary education and get the people motivated for sanitation related activities. For this purpose, Sanitary/Health Committee will be established in each of Eleven Centers. Members will be representatives from schools (Ministry of Education), the health center (Ministry of Health), municipality, Woreda council, MWR, Water Supply Section, WSS, Commercial Bank of Ethiopia (Finance Ministry), community, etc. The committee session will be convened regularly to discuss the way to promote people's sanitary awareness, to promote the installation of toilets, to acquire emptying equipment, to determine treatment/disposal sites and to evaluate the accomplishments.

6.3 Community Building/Participation and WID

Community building is based on the concept that development of a community can not be initiated from outside the community, if it is to be sustained in the long term. Change of gender relations for example requires a motivation for change from within the male and female membership of the society in order to alter the gender inequalities they consider to be present as they wish.

In many of the Study Centers, there has been a degree of dependency syndrome. This was felt most strongly in Bati, and other areas where there has been a history of relief aid. Lessons from the experience are pertinent to this Study. Giving of facilities or resources without individuals taking their own initiatives in the work will encourage the dependency. Followings are the focal points to get the community involved, built and participated:

- Utilization of Community's knowledge and information in the Project Implementation
- Unification of managers and users
- Community Management
- Establishment of Payment Policy during the construction

Females have lower earning ability than males, and tend to be in lower status jobs like housework, cooking, making alcohol, petty trading and so on. However, Water and sanitation programs are good starting point for raising community development issues, including gender issues. It is vital that all roles which are involved with this Project are treated in a consistent manner regarding both selection, support and remuneration. Lesser levels of these elements degrades any activity and devalues the person who fulfills that role. The Project should therefore include the following:

- Encourage diversity of roles between male and female
- Equity between both sex
- Income generation
- Gender orientation

Chapter 7 Project Implementation

7.1 Project Implementation

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

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 geographical relationship among centers.

- First stage : Preparation in 1996
- Second stage : Aykel, Debre Tabor, Nefas Mewcha and Werota ..... Group 1
  Chagni, Bure, Bichena and Dejen ..... Group 2
  Dupti, Mille and Bati ..... Group 3

7.2 Project Cost

Project costs for water supply are summarized in Tables 7.2.1 and 7.2.2 for each target year of 2005 and 2010. Also, the project costs for sanitary improvement are indicated in Table 7.2.3, consisting 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.

Table 7.2.1 Total Project Cost of Water Supply for Target Year 2005 in Thousand Birr

No.	Description	F.C.	L.C.	Total
1	Project			
1-1	Dupti	10,078	8,546	18,624
1-2	Mille	6,286	4,157	10,443
1-3	Bati	11,082	5,439	16,521
1-4	Werota	13,985	8,777	22,762
1-5	Aykel	13,138	6,340	19,478
1-6	Debre Tabor	20,097	10,579	30,676
1-7	Nefas Mewcha	13,968	7,248	21,216
1-8	Chagni	14,270	8,852	23,122
1-9	Bure	11,404	8,159	19,563
1-10	Bichena	10,609	6,162	16,771
1-11	Dejen	8,633	5,324	13,957
	Sub-total	133,550	79,583	213,133
2	Vehicles and office equipment	2,200	110	2,310
	Total	135,750	79,693	215,443
3	Price escalation	8,100	4,827	12,927
	Ground total	143,850	84,520	228,370
	Project cost B 200,477,000		(¥ 3,426 million)	
	Supporting cost by WSSD B 27,893,000			

Table 7.2.2 Total Project Cost of Water Supply for Target Year 2010 in Thousand Birr

No.	Description	F.C.	L.C.	Total
1	Project			
1-1	Dupti			11,681
1-2	Mille			5,649
1-3	Bati			7,448
1-4	Werota			6,988
1-5	Aykel			7,427
1-6	Debre Tabor			9,629
1-7	Nefas Mewcha			8,302
1-8	Chagni			8,560
1-9	Bure			7,915
1-10	Bichena			7,688
1-11	Dejen			7,858
	Sub-total			89,145
2	Transportation cost for construction equipment			1,800
	Total			90,945
3	Price escalation			38,197
	Ground total			129,142
				(¥ 1,937 million)

Table 7.2.3 Total Project Cost for Sanitation in Thousand Birr

No.	Description	2005	2010
1	Dupti	1,611	455
2	Mille	1,313	443
3	Bati	1,656	450
4	Werota	1,656	450
5	Aykel	1,421	443
6	Debre Tabor	1,968	450
7	Nefas Mewcha	2,063	450
8	Chagni	1,626	450
9	Bure	1,699	448
10	Bichena	1,553	448
11	Dejen	1,753	440
	Total	18,319	4,927

Chapter 8 Financial Analysis

8.1 Water Tariff

There is a limit for a household to pay for water. The World Bank recommends that the maximum limit of water charge be four percent of household income. With reference to the recommendation, it is proposed that the water charge for both house and yard connection owners be about four percent of their income, while the charge for public fountain users be about two percent of their income in the target year of 2010, considering the service mode.

Difference in household income between house and yard connection users is greater than the difference in water consumption between the two. It means that water price for the former can be higher than that of the latter despite the same four percent of their household income as the water charge, and thus house connection owners cross-subsidize yard connection users. In same way, connection owners cross-subsidize public fountain users in a dual manner under the proposed water tariff.

For non-domestic water users, the water price same as house connection owners, which is the highest, will be applied since they are usually bulk water consumers and more affordable than private users.

The proposed water tariffs for Eleven Centers are summarized below. It can be roughly said that the proposed water price per cubic meter is about three birr, 2 birr and 1 birr for house connection, yard connection and public fountain users respectively.

Table 8.1.1 Proposed Water Tariff in birr per cubic meter

	Dupti	Mille	Bati	Werota	Aykel	D/Tabor	N/M'ha	Chagni	Bure	Bi'na	Dejen
HC	3.26	3.03	3.06	3.01	3.15	3.67	3.50	2.93	3.00	3.43	3.00
YC	2.03	1.80	1.94	2.25	2.45	2.23	2.31	2.14	2.07	2.31	2.16
PF	1.51	0.89	1.05	1.04	1.11	1.66	0.82	1.33	0.76	1.48	1.06

Note; Water price for HC owners is applied to non-domestic customers.

8.2 Income of Water Supply

The major income source of water supply services is as every one knows water charge. There is second revenue source, which is technical service charge. It is the installation charge of connections, and the charge is 40% of the material and transportation cost actually incurred. The third revenue source is meter rent. For all new connections installed, the water meter will be rented. The rental fee is one birr per month. There are other revenues such as those from material sales, contract fee, connection fee, and etc, those of which are assumed to be two percent of the total of the preceding three revenues.

Eleven Center average of total revenues works out to 61 thousand birr in 1995. It is expected to grow to 430 thousand birr or 7.0 times as much in 2000, 763 thousand birr or 12.5 times as much in 2005 and 1,331 thousand birr or 21.8 times as much in 2010. The center average of the share of water charge revenue in the total revenues is calculated at 77% in 1995, and it is expected to be around 89% in the future.

8.3 Financial Analysis

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, such as electricity/fuel cost, disinfection cost, personnel cost, installation cost of connections, purchase cost of water meter and others including office supplies, uniform, per diem, travel, postage&telephone etc.

Capital cost is described in Chapter 7 and Eleven Centers' average of O&M cost in 1995 comes to 70 thousand birr. The O&M cost is expected to go up to 298 thousand birr or 4.3 times as much in 2000, 430 thousand birr or 6.1 times as much in 2005 and 633 thousand birr or 9.0 times as much in 2010.

After repeated simulations, the governmental subsidy shown in Table 8.3.1 is to be required for each of the Eleven Centers in order to have sound managerial indicators represented by revenues/expenditure and working capital/revenues shown in Table 8.3.2.

Table 8.3.1 Governmental Subsidy in Percent

	Dupti	Mille	Bati	Werota	Aykel	D/Tabor	N/M'ha	Chagni	Bure	Bi'na	Dejen
Subsidy to Initial Cost	50	90	80	60	100	55	75	85	95	65	85

Table 8.3.2 Managerial Indicators in Percent

	Dupti	Mille	Bati	Werota	Aykel	D/Tabor	N/M'ha	Chagni	Bure	Bi'na	Dejen
Revenue/ Expenditure	152.4	130.3	140.8	144.3	127.4	148.3	146.4	133.3	133.3	144.1	136.9
Working Capital/ Revenue	40.7	30.0	32.5	35.0	27.5	34.7	35.2	31.6	39.8	32.1	30.3

As the table shows, all the values exceed the required levels, those of which are preferably 110% for revenue/expenditure and 10% for working capital/revenue. It tells that WSS in every center concerned will be financially sound and stable in terms of earnings as well as solvency in the years to come, if all the above-mentioned conditions, estimates and assumptions are met.

Chapter 9 Project Evaluation

9.1 Economic Evaluation

There are two major economic benefits deriving from the Project; namely time saving benefit for collecting water and subdual of water-borne diseases. Among those, the former is considered as the economic benefit, since how many such diseases will be reduced is very difficult to estimate.

On the other hand, personnel cost is taken into consideration as the representative cost for the economic evaluation among costs consisting of capital and O&M because the capital cost and the whole O&M cost are too large in comparison with the benefit.

Based on the two above, cumulative benefit and cost for the period of 30 years have been calculated and the ratio (B/C ratio) is summarized below:

Table 9.1.1 Benefit and Cost Ratio in Percent

Items	Dupti	Mille	Bati	Werota	Aykel	D/Tabor	N/M'ha	Chagni	Bure	Bi'na	Dejen	Total
B/C Ratio	223	99	60	84	144	100	106	77	86	336	159	133

As the table shows, cumulative benefit is greater than cumulative cost in Dupti(223%), Aykel(144%), Nefas Mewcha(106%) Bichena(336%) and Dejen(159%). That is, for these centers, the time benefit is marked with being greater than the personnel cost of WSS especially in Dupti and Bichena. The cumulative benefit comes near to the cumulative cost in centers of Mille(99%), Werota(84%), Debre Tabor(100%), Chagni(77%) and Bure(86%), for which the time benefit is as big as comparable to the personnel cost of WSS.

The combined cumulative benefit and cost of the Eleven Centers comes to the ratio of 133%, which means the total benefit is considerably greater than the total personnel cost of Eleven Centers' WSSs.

9.2 Financial Evaluation

Initial cost is too huge for WSS in any of the Eleven Centers to bear. Therefore, financial internal rate of return (FIRR) was initially calculated on condition that the central government would provide subsidy, amounting to 80% of the initial cost, to each of the Eleven Centers. The FIRR is summarized in Table 9.2.1. The table shows that FIRR's are too low for Mille, Chagni, Bure and Dejen. FIRR for Aykel cannot be worked out because cumulative cost is greater than cumulative benefits. On the other hand, FIRR's are too high for Dupti, Werota, Debre Tabor, Nefas Mewcha and Bichena.

Table 9.2.1 FIRR with Government Subsidy of 80% to Initial Cost, Percent

Items	Dupti	Mille	Bati	Werota	Aykel	D/Tabor	N/M'ha	Chagni	Bure	Bi'na	Dejen	Total
FIRR	8.3	1.9	4.6	7.3	-	8.3	5.5	3.3	0.9	6.9	2.7	5.2

To arrive at the proper and reasonable level of FIRR, the governmental subsidy specified in Table 8.3.1 is finally proposed, and the financial internal rate of return (FIRR) based on the subsidy for each center is worked out below:

Table 9.2.2 FIRR with Government Subsidy specified in Table 8.3.1, Percent

Items	Dupti	Mille	Bati	Werota	Aykel	D/Tabor	N/M'ha	Chagni	Bure	Bi'na	Dejen	Total
FIRR	3.8	4.6	4.6	3.9	6.1	3.7	4.4	4.4	4.1	3.8	4.2	4.0

9.3 Organizational Evaluation

In the central level, strengthening of Planning Project Department was proposed. Task allocation was cleared in the regional level and the relationship between the central and regional was proposed to be strengthened. Those proposed set-up was made without imposing any drastic change of the existing ones, thus the proposed ones are expected to be realized without difficulty.

In center level, there will be four services under Manager of WSS; namely Administration, Financial, Technical and Sanitary Services, with Internal Audit and Customer Services. The proposed is an ultimate and exemplary one to be realized in the target years of 2005/2010. The organizational set-up could be realized without difficulty, because the actual organization is to be gradually achieved starting from the existing one with adding sections under the services and the staff.

9.4 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 borehole casing, the light material could facilitate the construction work very smoothly.

In Bure, spring water will be continuously adopted as it has been in order to meet the water demand. In this case, water quality analysis shall be employed in daily inspection, composed of mainly turbidity and biological aspects. The same manner of water quality analysis should also be adopted in Dupti, because the water is from shallow wells.

9.5 Environmental Impact Assessment (EIA)

In this Study, initial environmental examination (IEE) firstly had been carried out throughout Phase I study and supplemented during the field survey of Phase II, in terms of social environment, natural environment and public nuisance. The IEE concluded that the Project would give no advance impact or give negligible impact to the environment, or rather give enhancement in some fields such as economic activities, public health and hygienic condition, leaving some items to be unknown.

The items classified as unknown are such as vested right, public health and hygienic condition, accidental damages to facilities, soil erosion, surface water quality and quantity, groundwater quality and quantity, land subsidence, and traffic nuisance. Those had been undertaken for EIA, and no negative environmental impact were not expected except groundwater quality in Dupti. The water supply system in Dupti is expected to use shallow aquifer, therefore the groundwater in Dupti should be utilized with the monitoring of groundwater quality.

9.6 Indirect Benefit Evaluation

Among the top ten diseases, such water/excreta born diseases as intestinal parasite and diarrhea had been usually found with high incidence. Generally, it is said that the effects of poor water supply, unhygienic practice and unsanitary excreta disposal lead to about 70% of total disease incidence in Ethiopia. With the completion of this Project, those water/excreta born diseases could be subdued and the number of the patients, ranking at present, could reduce especially for diarrhea.

Water has especially strong impacts on manufacturing industry such as food and beverages, hotels, restaurants & bars, and hospitals. In an event water is sufficiently supplied through this Project, the center's economic activities will be stepped up, centering on them.

By improving th piped water supply, the intended benefits will include the significant reduction of time and energy spent in collection of water, particularly for women but also for girls and boys under the age of 15 years. This will allow women more time for other activities including relaxation or income generation activities, and improved sanitary behaviors. It will allow girls and boys more time for studying.

The Project will also give women employment opportunities at the implementation as well as the operation and maintenance stages. The employment in the latter is often permanent. Female employment en masse at this stage will contribute to the elevation of female status in the society.

In general, the level of access to water and sanitation currently existing for Muslims and Christians is almost the same over Eleven Centers. The level of income for these two religious groups is also similar. As a result, the benefits of the Project are likely to permeate to all ethnic groups and religious groups at a similar level. The benefits of time and energy savings allow time for other things, an improved of health and well-being, and increased feeling of power over their own lives.

Chapter 10. Development Strategy of the Project

10.1 Summary of Eleven Centers

The Eleven Centers is summarized in reference to the urgency, level of the need and the project impact. The items have been considered in order to summarize the situation of water supply of Eleven Centers, those of which are: 1) current water service (represented by water consumption per person per day: WC/P/D), 2) number of existing water source(s), 3) level of water need, 4) level of superannuation or timeworn-out, 5) economic benefit (B/C ratio), 6) occurrence of water-borne-diseases, 7) population growth rate, 8) economic activities (substituted by number of hotels and restaurants), and 9) level of indirect benefit.

Among those items above, the first three items such as item 1) "water consumption per person per day", item 2) "number of existing water source(s)" and item 3) "water need" are highly considered in the stage of inplementation, since this Project is expected as an emergency measure to improve/enhance the current deteriorating water supply rather than one which could bear certain benefit.

Table 10.1.1 presents the summary of those items mentioned above. Aykel and Nefas Mewcha are currently equipped with only one water source, which covers a little water consumption, and the population's water need is very high. Although Debre Tabor is equipped with two boreholes, both the current water consumption and the water coverage ratio are very low.

10.2 Project Implementation Program

The implementation of Eleven Centres project is proposed to be divided into three groups, taking into consideration the geographical relationship among Eleven Centers. The geographical relationship is considered on condition mainly represented by the distance among centers. The groups are proposed as mentioned below:

Group I	: Aykel, Debre Tabor, Nefas Mewcha, Werota	... 4 towns
Group II	: Chagni, Bure, Bichena, Dejen	... 4 towns
Group III	: Dupti, Mille, Bati	... 3 towns

Table 10.1.1 Summary of the Centers

Items	Dupti	Mille	Bati	Werota	Aykel	Debre Tabor	Nefas Mewcha	Chagni	Bure	Bichena	Dejen
1. WC/P/D,liter Water Coverage, %	17.4 45	17.8 98	16.0 87	8.0 96	2.3 71	3.7 34	4.7 93	12.3 46	10.7 83	8.1 67	9.9 83
2. No. of Existing Water Sources	2	2	4	1	1	2 (3)**	1	1	2	2	1
3. No. of Water Need/ 100 Household	15	12	0	11	32	15	45	23	30	21	40
4. Superannuation*	2	1	3	1	1	2	1	1	3	2	1
5. B/C Ratio, %	223	99	60	84	144	100	106	77	86	336	159
6. Water-borne Disease per year as %	21	9	17	17	25	18	34	9	21	11	8
7. Population Growth Rate, %	5.0	8.0	3.5	6.0	5.5	4.5	7.0	7.5	5.0	5.0	3.0
8. No. of Hotels&Rest-nts/100 population	22	45	4	9	10	22	15	3	4	3	7
9. Indirect Benefit***	2	2	3	2	1	1	1	2	2	2	2

Note: * 1 : Severely worn-out, 2 : Fairly worn-out, 3 : Worn-out
** The third borehole is expected to start the service in November, 1995.
*** 1 : Highly expected, 2 : Fairly expected, 3 : Expected

10.3 Project Cycle Management (PCM)

PCM is a management tool for development project, covering all stages such as planning, implementation and monitoring/evaluation. PCM is composed of three steps; namely participatory planning, appraisal and monitoring/evaluation, and provides consistency and logicality throughout the project cycle. A format called Project Design Matrix (PDM) is produced to interlink these three steps with each other at the participatory planning stage. In this Study, the first step of PCM is conducted with producing a PDM, and the latter two steps are to be carried out after the completion of the Study and throughout the implementation and monitoring/evaluation stages.

Participatory planning is further divided into such steps as participation analysis, problem analysis, objectives analysis, alternatives analysis, project design matrix and plan of operations.

Participation analysis has been carried out, aiming at understanding the social and cultural factors in the Project area. People, groups and organizations, which may be affected by the Project, has been analyzed at the beginning of the Project planning stage through meetings with various focused groups and interviews with key informants.

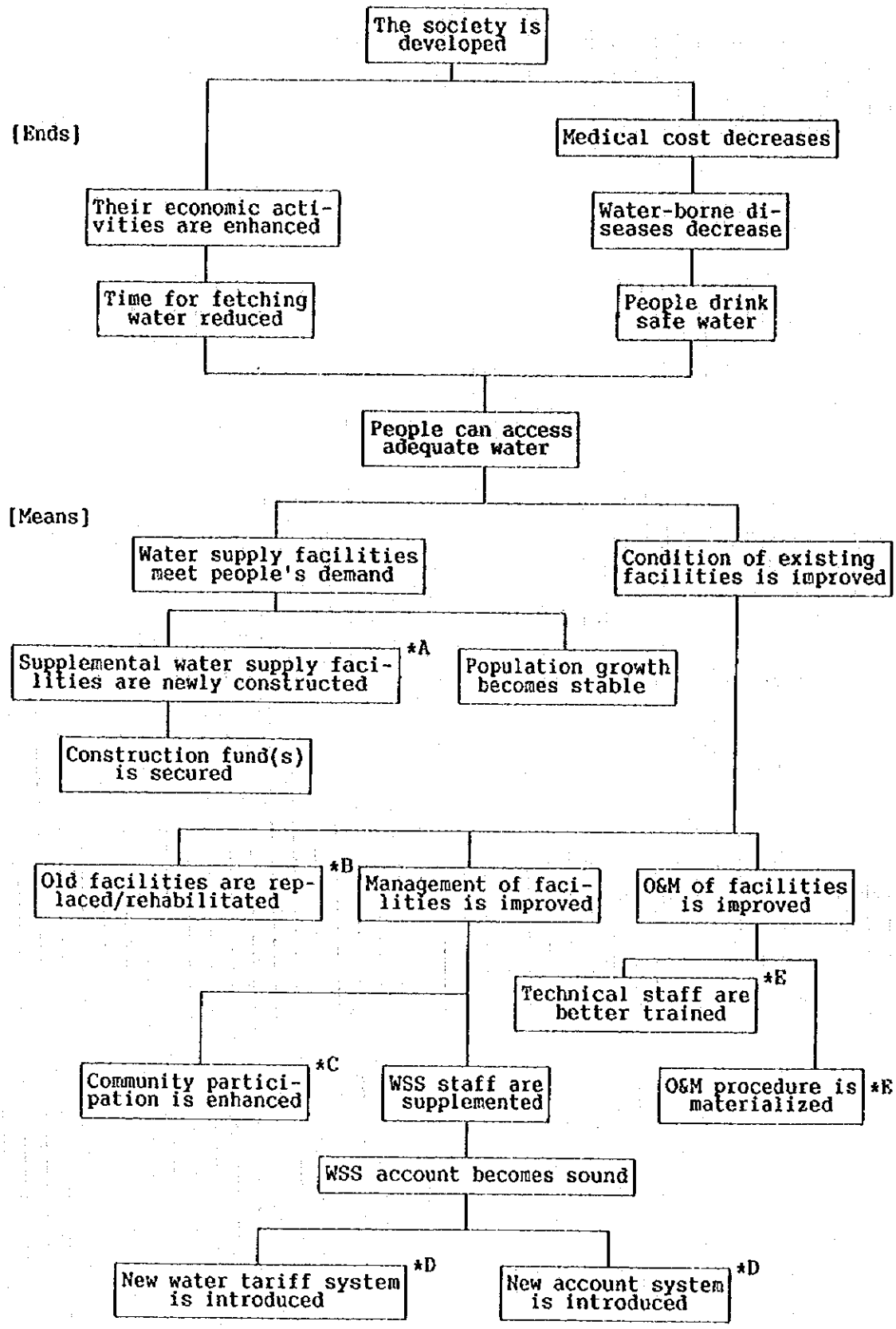
Problem analysis clarified "Cause and Effect" relationship of the existing problems with setting the core problem "People cannot access adequate water" at the beginning. By rewording the negative "Cause-Effect" relations, an objective tree can be presented, which describes the means for solving the problems and the effects of the solutions. The objectives tree shown in Figure 10.3.1 identifies the "desirable conditions" after the problems are solved, and becomes the basis for the examination of the approaches for improving the situation.

With consideration of alternative plans, the project components are suggested as listed below with same reference items of A, B, C shown in the figure. Item "F. Enhancement of sanitary facilities and people's awareness" is additionally considered to keep water source(s) free from contamination, to enhance the effect of water supply project, and thus to contribute to developing the society.

A. New facilities construction
B. Rehabilitation and/or replacement of existing facilities
C. Community building/participation and WID
D. Application of new financial management scheme
E. Materialization of O&M and training program of technician
F. Enhancement of sanitary facilities and people's awareness

PDM is a format which indicates the major components of the Project identified above. The PDM is briefly shown in Table 10.3.1, stating objectives, how the objectives are achieved, external factors which play the key role in achieving success, the means with which the evaluation is made, and necessary inputs of the Project.

The plan of operation is a tool for operational management of the Project and is essential material for monitoring and evaluation. The plan of operation is to be made after appraisal of this Project, consisting of activities, expected results, schedule, responsible post, inputs and necessary conditions, most of which are from the PDM.



Note: "*" is an indication of project components.

Figure 10.3.1 Objectives Tree in the Society

Table 10.3.1 Project Design Matrix

Narrative Summary	Verifiable Indicators	Means of Verification	Important Assumptions
Overall Goal 1. Service of water supply is improved.	By year 2010, water is served to the target coverage with amount of more than 70% of the water demand without interruption more than 2 weeks a year.	WSS operation record	WSS management is stabilized.
2. Water-born diseases are subdued.	By year 2010, the diseases reduced by 20%.	Records in medical institutions	Medical institutions are involved.
Project Purpose 1. Water service coverage is improved with required water demand.	By year 2005, water is served to the target coverage with amount of more than 50% of the water demand.	WSS operation record	1. Electricity is not interrupted. 2. Trained technicians continue working. 3. Population growth meets projected one.
2. Sanitary facilities are improved.	Toilet coverage is increased by 30%. Drainage coverage is increased by 40%.	Municipality records or sampling survey	4. No. of hotels/ restaurants is not increased rapidly.
Outputs 1-1. New wells are constructed with new distribution system. 1-2. Aged facilities are renewed. 2. System failure is reduced. 3. WSS account is improved. 4. Public fountain is managed by community. 5. Toilet can be served. 6. Stagnant water reduced.	1. Complaints against WSS are reduced. 2. No. of interrupt'n reduced by 50%. 3. The account becomes black. 5. Toilet coverage is improved by 20%. 6. Drainage coverage is improved by 30%.	1. Complaints records or sampling interv'w 2. WSS operation record 3. Accounting book 5. Municipality records or sampling survey	1. Fuel or electricity for driving the system supplied fully. 2. Trained technicians continue working. 3. Population growth meets projected one.
Activities 1-1. Construct newly required facilities. 1-2. Rehabilitate and/or reprice the aged facilities. 2-1. Introduce new O&M system 2-2. Train mechanics. 3. Introduce new tariff and accounting system. 4. Make arrangement for community participation. 5-1. Make arrangement for subsidy of toilet const'n. 5-2. Construct public toilet as required. 6. Construct and/or renovate drainage system.	**Inputs** Construction equipment and machinery Materials Submergible pump Generator Casing Distribution pipes & connections Concrete materials ※ Details are described in each center's report.		1. Materials, equipment and machineries are supplied in time 2. Land acquisition is made in time. **Pre-condition** Residents don't object the Project.

Chapter 11 Conclusion and Recommendation

11.1 Conclusion

Taking current water situation into consideration, water supply has been planned in terms of both rehabilitation and new-construction with the target years of 2005 and 2010. In this Study, water coverage in year 2010 is targeted to be between 75 % and 100 % with reference to the current coverage. Water demand is to be realized after completion of the Project with the volume estimated on the basis of 15 lpcd for public fountain, 35 lpcd for yard connection and 60 lpcd for household connection respectively.

For sanitary improvement, some types of toilet such as individual, community and public have been designed, those of which can be easily copied to facilitate the diffusion of such toilets. Typical sections of drainages are also shown in this Study, and those are can be constructed by community level. Also, sullage disposal pit was shown, contributing to the disposal of household waste water. Sanitary education video and education manual will greatly contribute to the diffusion of sanitary education program, getting community involved, participated and motivated.

With reference to above, this Project shall be put the highest priority in the water supply sector for rural towns and be commenced immediately to mitigate the deteriorating condition shown in all Centers. The construction work will be commenced in considering the urgency, geographical condition among centers and the construction amount. With completion of this Project, the followings are to be realized:

- Improvement of current deteriorating water supply
- Improvement of poor sanitary condition prevailing centers
- With both above completed, subdual of water/excreta born diseases, enhancement/strengthening of community, motivation of community, reduction of overburden incurred by fetching water for specially women and girls, and enhancement of economic activities, thus achieving the sound life in Eleven Centers.

11.2 Recommendation

As mentioned above, this Project was concluded to be carried out immediately taking into consideration both current deteriorating condition and the effect to be born by the Project. Followings are recommendations to be undertaken during construction work as well as after completion of the Project:

- Coordination among related departments located under Ministry of Water resources (central government) shall be made with Water Supply and Sewerage Service Department being the pivot, and coordination among the central, the regional and the center shall also be effectively made. For this purpose, the Project Manager shall be appointed and a committee composed of above three level is required under the manager in order to coordinate and facilitate the implementation.

- Hydroelectricity is to be extended into such centers as Dupti, Aykel, Nefas Mewcha and Dejen by the first target year of 2005, while Mille and Chagni do not have the schedule at moment (Other centers are already supplied with hydroelectricity). Those centers, which are scheduled to have hydroelectricity, shall keep pace with the Project implementation for being extended the hydroelectricity since the operation cost of hydroelectricity could be around 60% of that of diesel generator (Financial analysis for those centers was made on condition that the hydropower was available).

- In line with the implementation of water supply project, progressive water tariff structure and double entry accounting system should be introduced. The former scheme can raise the average water tariff without affecting low-income households. The latter can draw real picture incorporating depreciation and interest payment so that WSS can have not only enough operation and maintenance cost but also fund to expand the water supply system by themselves.

- The related organizations, specially WSS, should be strengthened as programmed in order to manage the enhanced water supply and sanitation facilities effectively. WSS will have authority to revise water tariff, dismiss or employ its staff and launch on new investment subject to regional office, so that WSS will have self-independent sense and can stand on their own feet.

- A committee, composed of health/sanitary relating organizations, shall be established in each center in order to improve sanitary and health condition. This committee can also coordinate communities in preparing sanitary facilities such as toilet, sullage disposal site, drainage and etc. WSS should facilitate the coordination of the committee.

- In centers where detail topographic map is not available, topographic survey shall be carried out along planned rising and distribution pipelines, at well sites and reservoir sites. Land acquisition, where required in such works of rising main, reservoir and well, shall be made in time before the commencement of the construction.

- In many of the Study centers there has been a degree of dependency syndrome. This was felt most strongly in Bati, and other areas where there has been a history of relief aid. To get the community motivated and empowered, it is very efficient if the management and operation of facilities are made by the community itself. In this regard, "Community Management of Public Fountain" and "Community Management of Community Toilet" are recommended. According to the household survey, the majority of people are in favor of the public fountain managed by the community.

- Community, particularly women and girls, must be involved in confirmation of the water supply and sanitation facilities design, system and devices at the commencement of the implementation stage. This is made specially for finalization of public fountains' design and location, design of toilet facilities, and management scheme of those facilities. Exercises of involving the community are extremely

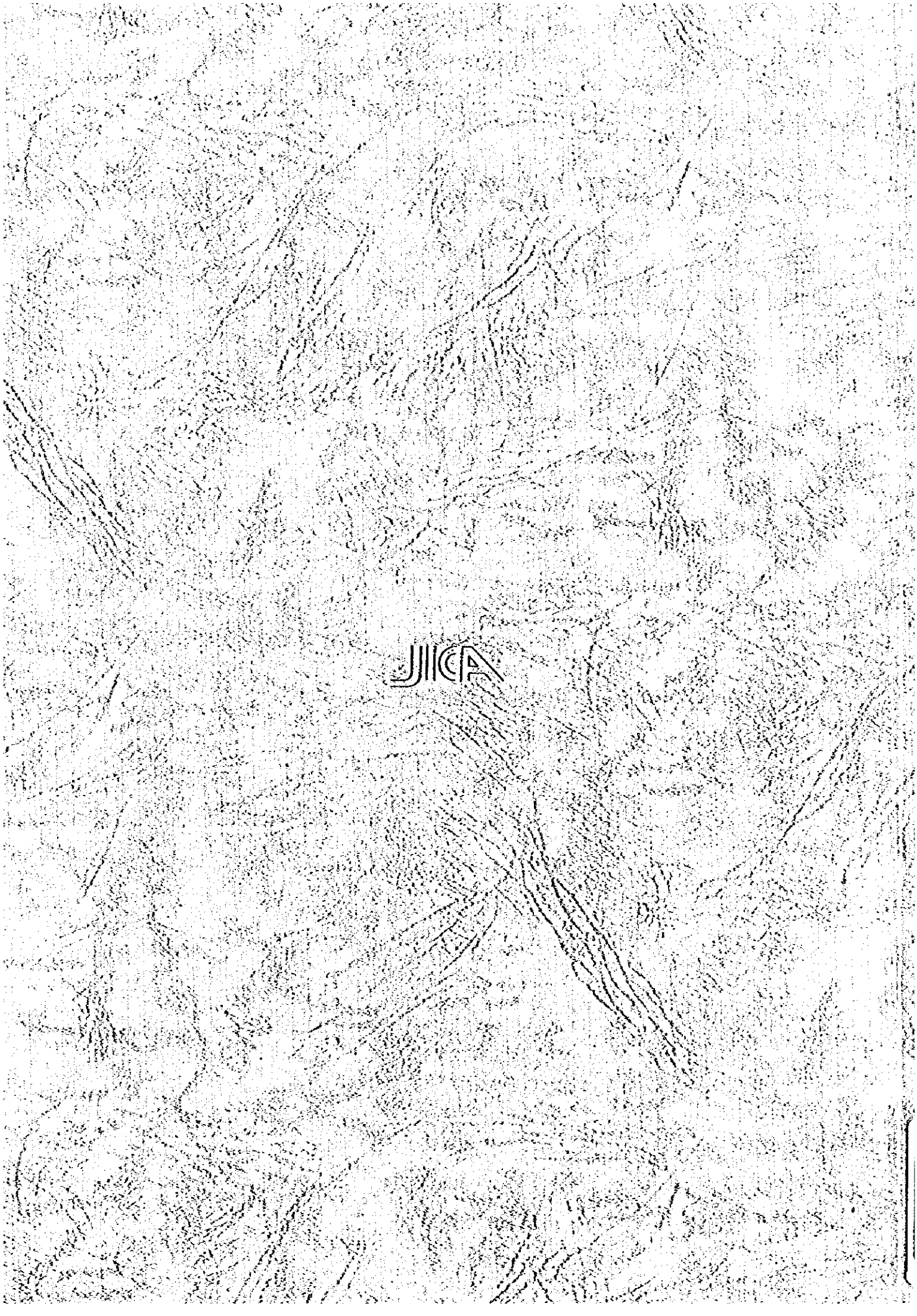
motivating factor. It provides them with a feeling of involvement and thus provides empowerment.

- Community participation promoter(s) should be assigned in line with the implementation of the Project, who will be responsible for coordinating instructions for the community members on the design, construction and operation and maintenance of the water and sanitation facilities as part of the long term sustainability. Also, a CPP supervisor shall be dispatched from WSSD on occasional basis to facilitate the CPP's work.

- Sanitary education manual and video titled "Simple Steps...for Better Health" should be fully utilized for the purpose of diffusion of sanitary education program as well as motivating the population for better sanitary activities. The sanitary education manual will be modified, if necessary, according to the response of the attendants, since the manual has not been tested.

- Results of the analysis for access and control suggest that they share resources with men equally within the home but that female headed households tend to be poorer than their male counterparts. Female headed households are particularly vulnerable and special attention must be paid to them during implementation to make sure that they are benefiting adequately from the Project, and this should be monitored.

- Monitoring should be made in line with the project cycle to confirm and measure the benefits to be born by this Project, those of which are increase of water coverage and water amount, subdual of water/excreta borne diseases, motivating community, reduction of time for fetching water and activating economy.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