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No. 22
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)
MAIN REPORT
(Volume I)

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)
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PREFACE

In response to a request from the Government of Federal Democratic Republic of Ethiopia (GOP), the Government of Japan (GOJ) decided to conduct a feasibility study on Eleven Centers Water Supply and Sanitation and entrusted the Study to Japan International Cooperation Agency (JICA).

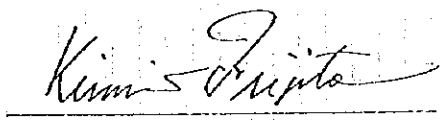
JICA sent to Ethiopia a study team headed by Mr. Kazunori TAMAKI, Sanyu Consultants INC., and composed of staff members of Sanyu Consultants Inc. and Kyowa Engineering Consultants Co., Ltd. three (3) times between December 1994 and January, 1996.

The Team held discussions with the officials concerned of the Government of Ethiopia, and conducted field surveys in the Study area. After the Team returned to Japan, further studies were made and the present report was prepared.

I hope this Report will contribute to the promotion of the Project and to the enhancement of friendly relations between our countries.

I wish to express my sincere appreciation to the officials concerned of the Government of Federal Democratic Republic of Ethiopia for their close cooperation extended to the Team.

February, 1996



Kimio FUJITA
President
Japan International Cooperation Agency

February, 1996

Mr. Kimio FUJITA
President
Japan International Cooperation Agency
Tokyo, Japan

Letter of Transmittal

Dear Sir,

We are pleased to submit the study report on the Eleven Centers Water Supply and Sanitation. This Report incorporates the advice and suggestions of the authorities concerned of the Government of Japan and your Agency as well as the formulation of the above-mentioned project. Also included are comments made by Water Supply and Sewerage Service Department (WSSD) during the discussions which were held in Addis Ababa.

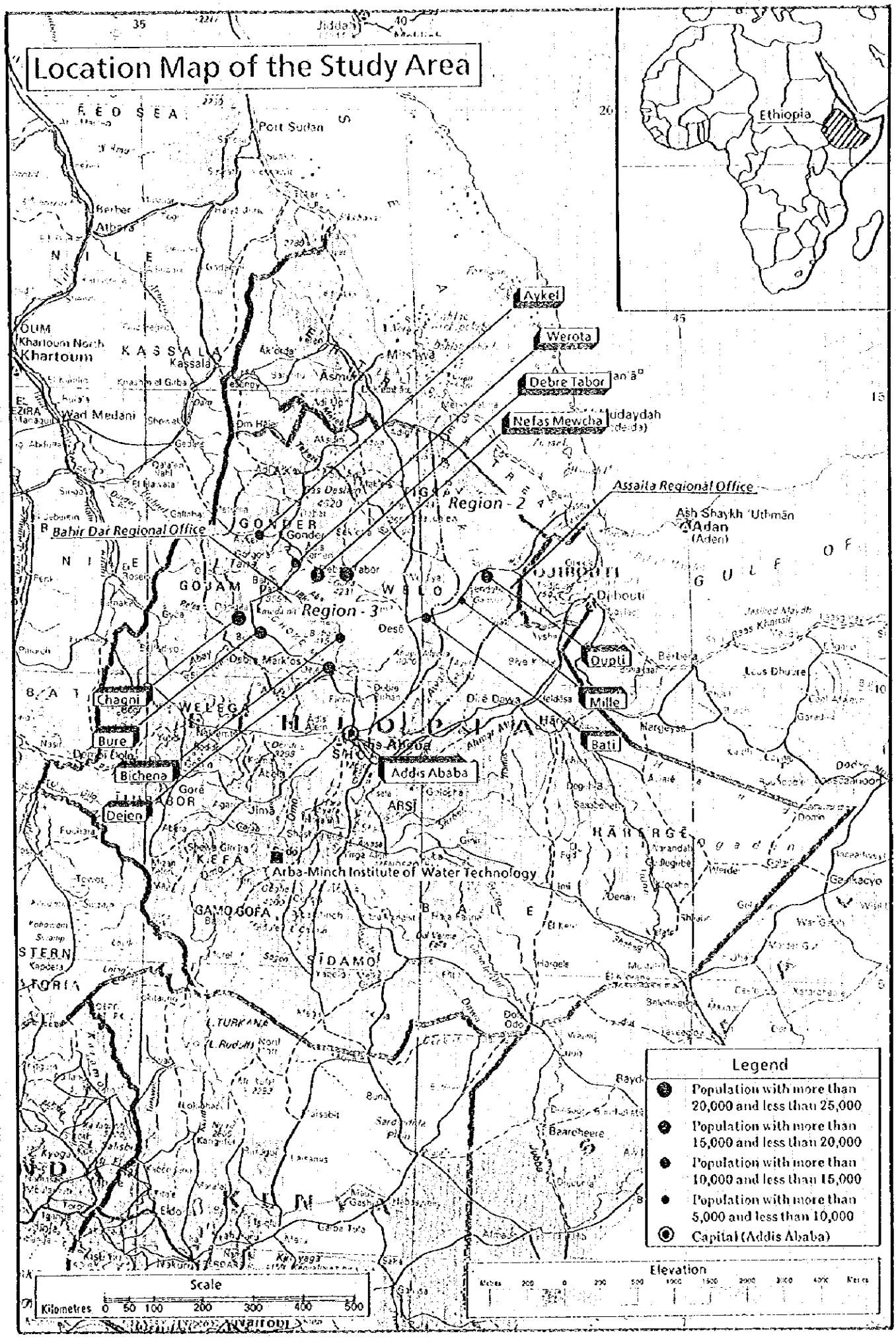
The Study had been carried out in the Eleven Centers; namely, Dupti, Mille, Bati, Werota, Aykel, Debre Tabor, Nefas Mewcha, Chagni, Bure, Bichena and Dejen. Based on the Study, this report presents a scheme of water supply and sanitation improvement concerned of the Eleven Centers. After completion of the Project, water service ratio will increase up to between 75% and 100% with enough volume of water in the target year of 2010 from the current 34% to 98%. As well, the sanitary condition of the Eleven Centers will be improved in line with the adequate water supply.

In view of the urgency of the water supply and sanitation in the Eleven Centers, we strongly recommend that the Government of Federal Democratic Republic of Ethiopia accord this Project as top priority for implementation.

We take this opportunity to express our sincere gratitude to your Agency and the Ministry of Foreign Affairs as well as to the Water Supply and Sewerage Service Department (WSSD) of the Ministry of Water Resources (MWR) and other authorities concerned of the Government of Federal Democratic Republic of Ethiopia for the close cooperation and assistance extended us during the entire period of the Study.

Very truly yours,

Kazunori TAMAKI
Team Leader
The Study on Eleven Centers
Water Supply and Sanitation


Location Map of the Study Area
Ethiopia
Port Sudan
Aykel
Werota
Debre Tabor
Nefas Mewcha
Assaita Regional Office
Bahir Dar Regional Office
Region - 2
Region - 3
Ash Shaykh 'Uthmān
'Adan
(Aden)
Djibouti
Dupti
Mille
Bati
Chagni
Bure
Bichena
Addis Ababa
Deje
Arba-Minch Institute of Water Technology
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	3m³ ×2* 4	45m³ * 4									
		+20m³	+20m³	+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		360m³	140m³	240m³	480m³	130m³	400m³	260m³	330m³	110m³	160m³	140m³	
2005/2010		(180×2)	(70×2)	(120×2)	(240×2)	(65×2)	(200×2)	(130×2)	(165×2)	(55×2)	(80×2)	(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	528	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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ABBREVIATIONS

[ORGANIZATION]

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

GLOSSARY

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

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

[OTHERS]

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

Exchange Rate

1 US Dollar = 6.3 Birr

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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 (Letter of Sector Policy, July 1995 WSSA).

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

In the face of the political and economic crises, and man-made disasters which have continued to afflict this country for the past years, a multitude of constrains have greatly suppressed the possibility of achieving the targets which have been set for the water and sanitation sector. Also, frequent government changes in staffing have caused repeated beginnings with few project endings. Lack of sufficient involvement from project beneficiaries have forfeited success and sustainability of most projects.

The man-made disasters led to suspension of civil work and increase of population flux of repatriates from the neighboring countries. Since the northern part such as Afar Region (former Region-2) and Amhara Region (former Region-3) were most affected, many of the water supply system were destroyed, and the water supply coverage of the rural centers is said to be as low as 10 %.

Although Ethiopia is believed to have vast water resources in general, recurrent drought situations have been caused by erratic and unreliable rainfall. The northern part of Ethiopia such as Afar and Amhara Regions have been most seriously damaged by droughts, specially that occurred in 1984. These regions suffer from shortage of water in the dry season even in the normal year.

In view of the above situation, the Government of Ethiopia (GOE) put priority on the Eleven Centers Water Supply and Sanitation among 230 rural centers listed in the National Development Plan (ERRP 1993-95). 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 those, Dupti and Mille are located in Afar Region, and others are located in Amhara Region.

1.2 Overall Progress of the Study

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

The Team had collected and reviewed the existing data and information related to the Study in the early stage of the Phase I study, and also contacted organizations/institutions related such as Ethiopian Water Works Construction Authority (EWWCA), Water Well Drilling Enterprise (WWDE), Ministry of Health (MOH), UNICEF and so forth.

After reviewing the data and information gathered, reconnaissance survey covering all Eleven Centers had been carried out throughout the month of January by the Team members and their counterparts. The survey was conducted to recognize the overall situation of the centers, give common understandings among the members, and identify the centers to be studied in Phase I and Phase II respectively. During Phase I survey/study, such centers as Dupti, Mille, Bati and Werota were selected for the detailed survey, while the remaining centers in Phase II. The survey items and major activities are summarized in Table 1.2.1.

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

For the geological part, geo-electric prospecting (GEP) survey had been conducted to identify the hydrogeological condition to be required for designing water supply systems. The 15 to 20 points at each center had been prospected with a maximum depth of 150 meters.

Water quality of the existing water sources and surface water had been examined in terms of physico-chemical characteristics. The analysis items and procedure were made in accordance with WHO drinking water quality guidelines. Also water samples had been undertaken for bacteriological tests, which were collected from the water sources, public fountains, private connections and household containers in order to identify the place of contamination. The bacteriological test is aimed at contributing in the analysis of hygiene awareness and sanitary education programmes. The potability has been checked according to the guideline values set by WHO for drinking water.

Topographic survey had been made along the existing water supply transmission lines and distribution lines through the reservoirs. Also, proposed water supply distribution lines, which start at prospective water source(s) identified by GEP, had been surveyed. Stadia-traverse surveying method had been employed for the topographic survey. In parallel with the topographic survey, the present conditions of the existing water source and water supply facilities as well as water supply organizations and their O&M had also been examined.

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

Survey of sanitary and health condition had been also carried out together with the above water use condition survey. Interviews had been conducted at the above 100 households, and sanitary facilities such as the type of toilet, condition of facility and utilization, treatment of dejecta/excretion and situation of solid wastes disposal had been observed. This survey has studied habits and tradition in excretion and use of toilet by sex and tribe separately in order to determine the social acceptability in introducing use of toilet. The survey had also grasped the trend of the population with respect to the sanitary/hygiene, and also clarified the people's awareness on sanitary/hygiene condition.

Survey of social background aims at minimizing the possible negative effects which may be expected on the society and the people. The survey had been carried out by the same 100-household-interviews, questioning key informants such as Woreda, Kebele, school teachers, health workers and other community leaders, and meetings with various focused groups. Among these, the meeting with various focused groups (so-called group meeting) was found by the Team to be effective in understanding the people's social background, awareness on water use and sanitary/hygiene as well as their perceived needs and priorities.

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

Initial environmental examination (IEE) had been carried out on all Eleven Centers during reconnaissance and Phase I surveys. The IEE had been made based on the "Guideline of Environmental Consideration for Groundwater Development" prepared by Japan International Cooperation Agency (JICA), and the prevailing natural and social environment had been studied. As a result of IEE conducted in Phase I, detailed environmental survey had been carried out during Phase II survey in accordance with the terms of reference made on IEE. Based on the result of IEE and the detailed environmental survey, environmental impact assessment (EIA) for each center had been made in parallel with the project formulation.

Beside the surveys mentioned above, experimental toilets were constructed, and sanitary education practice, current measurement at a river in Bure, pumping test and existing pump investigation had been additionally executed during Phase II.

The experimental toilet (community-type) was constructed each at Werota and Bati to promote sanitary awareness of the population in close cooperation with the beneficiary. Sanitary education was also implemented through experimental practices such as street

theater performed by school children, sanitary education video and meetings with various focused groups as well as concerned organizations. The video titled "Simple Steps.....for Better Health" was firstly introduced in this water & health sector of Ethiopia with different languages as Amharic, Afar and English.
Staff gauge was installed in a river named Manzana at Bure to measure the daily water level, and the currents of the river had been measured for about one month to establish the rating curve. The stream is a prospective water source in Bure since the groundwater is highly mineralized that people can hardly drink.

To evaluate well yield and interpret the aquifer characteristics, pumping test had been carried out for the existing wells in Bati, Bure and Aykel, which test would give little effect to the current water supply. The pumping is composed of preliminary, step-drawdown, constant discharge and recovery tests.

About half of the existing pumps had been taken out to check the specifications, physical condition and level of wear/tear which determine the necessity and urgency of rehabilitation. The investigation had also obtained other related data such as water level, specifications of riser pipe and well diameter. This investigation had faced difficulty of carrying out all existing wells because some pumps and riser pipes were so corrosive to be re-assembled.

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

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

Table 1.2.1 Overall Progress of the Work up Todate

Work & Duration	Major Activities
Phase I Study	
Preparatory Work	1. Review of Data and Information Available
Dec. 17, 1994 -	2. Preparation of Inception Report
Dec. 28, 1994	3. Procurement and Provision of Necessary Equipment
First Field Survey	1. Explanation and Discussion of Inception Report
Jan. 4, 1995 -	2. Collection and Review of Data/Information Related
Mar. 28, 1995	3. Survey for Meteorology and Hydrology
	4. Survey for Hydrogeology Accompanied by GEP
	5. Water Quality Test
	6. Topographic Survey for Existing/Proposed Pipelines
	7. Survey for Water Supply System and its O&M
	8. Survey for Water Use including Consumption Census
	9. Survey for Sanitary & Health Condition
	10. Survey for Social Background & People's Awareness
	11. Survey for Socio-Economy
	12. Initial Environmental Examination
	13. Formulation of Concept of Sanitary Improvement Plan
	14. Preparation and Discussion of Progress Report
Phase II Study	
Second Field Survey	1. Survey for Meteorology and Hydrology
May 12, 1995 -	2. Survey for Hydrogeology Accompanied by GEP
Sep. 4, 1995	3. Water Quality Test
	4. Topographic Survey for Existing/Proposed Pipelines
	5. Survey for Water Supply System and its O&M
	6. Survey for Water Use including Consumption Census
	7. Survey for Sanitary & Health Condition
	8. Survey for Social Background & People's Awareness
	9. Survey for Socio-Economy
	10. Construction of Experimental Toilet
	11. Experimental Practice of Sanitary Education
	12. River Water Level Gaging and Current Measurement
	13. Pumping Test
	14. Investigation of Existing Pump
	15. Environmental Survey
	16. Formulation of Basic Strategy of the Project
	17. Preparation and Discussion of Interim Report

Work & Duration	Major Activities
Home Work Aug. 22, 1995 - Nov. 3, 1995	1. Formulation of Water Resources Development Plan 2. Formulation of Water Supply Project 3. Formulation of Sanitation Improvement Plan 4. Formulation of Strengthening Organization 5. Preliminary Construction Cost Estimation 6. Project Evaluation 7. Formulation of Implementation Program 8. Preparation of Operation and Maintenance Manual 9. Preparation of Sanitary Education Manual 10. Preparation of Draft Final Report
Third Field Survey	1. Explanation and Discussion of the Draft Final Report
Home Work	2. Preparation of Final Report

continued

Note: 1. Items 3 to 7 in First Field Survey had been carried out at three (3) centers of Dupti, Mille and Bati.
2. Items 8 to 11 in First Field Survey had been carried out at four (4) centers of Dupti, Mille, Bati and Werota.
3. Items 1 to 9 in Second Field Survey had been carried out at the remaining centers.

1.3 Related On-Going and Programmed Projects

Besides the Eleven Centers studied by the Team, 10 on-going and programmed water supply and sanitation projects were identified by the Planning & Programming Department, Water Supply and Sewerage Agency (Refer to Table 1.3.1). They are all the central government projects, which comprise 80 towns with about 2,150,000 population involved. Out of the 11 projects, six are going to be started in 1995 or the following year. The remaining five projects have been already started.

Out of the 11 projects four are under the feasibility study, while the remaining seven are under construction by nature. In the case of feasibility study, the foreign component of the project cost is granted and in the case of the construction project the foreign component is provided in a soft loan.

The external financing organs are International Bank for Reconstruction Development (IBRD), African Development Bank (ADB), African Development Fund (ADF), Japan International Cooperation Agency (JICA, Japan), Kreditanstalt Fuer Wiederaufbau (KFW, Germany), ORET (Netherlands), etc.

The amount of project cost ranges from 2,500,000 birr to 340,000,000 birr, following the involved population ranging from about 24,000 to 550,000. The project period ranges from

six months to four years. Some projects started in as early as 1991 and others are due to be completed in year 2000.

The name of each project and a supplementary information are given below with reference to Table 1.3.1.

- Twenty-Five Towns WS Feasibility Study, Design & Rehabilitation is now at the appraisal stage by IBRD. It is consisted of two parts; namely, one is the capacity building of regional offices, and the other is the rehabilitation of water supply facilities for the towns.

- Twelve Towns WS Feasibility Study & Design is scheduled to be completed this year. This is being carried out by the joint venture of GIBB (UK) and SEURECA (France), and financed by ADF.

- Three Towns WS Feasibility Study has not yet started. It will be financed by KFW.

- Twelve Towns WS Expansion & Rehabilitation is a German assisted project financed by KFW. It is scheduled to be completed this year. The consultant is Consulting Engineers Salzgitter (Germany) and the contractor is Wiemer & Trachte Contractors (Germany).

- Two Towns WS Project is now under way. It is financed by IBRD. The consultant is Tahel Consultant (Israel) and the foreign contractors are Feljas & Masson (Finland) and Compagnie Generale de Travaux d'Hydraulique (France).

- Ghimbi & Woldia WS Project is going to be completed this year. It is financed by ADB. The consultant is Consulting Engineers Salzgitter and the foreign contractor is Josef Riepel (Germany).

- Seven Towns WS Project is now at the appraisal stage. It may start this year or next year. It will be financed by ADB. The consultant will be DEVECON (Finland).

- Three Towns WS Project will start next year. The selection of the donor is now under way.

- Adwa WS Project will start next year. Possibly it would be financed by ORET.

- Axum & Lalibela WS Project is going to start this year. It will be financed by ORET. The consultant and the contractor will be DEVECON and Vemeer International (Netherlands) respectively.

Table 1.3.1 On-Going and Programmed Water Supply Projects

No.	Name of Project	Nature of Project	Towns Involved	Population Involved	Cost and Sources	Period	Progress to Date
1.	25 Towns WS Feasibility Study, Design & Rehabilitation	F/S, Design & Rehabilitation	*1	549,195	(mln US$) IBRD : 26 TGE : 21 Others : 2 Total 49	Oct. 1995 - 1999 (4 years)	
2.	12 Towns WS Feasibility Study & Design	F/S & Design	*2	278,134	(mln birr) ADF : 13.4 TGE : 3.1 Total 16.5	Sep. 1993 - Mar. 1996 (2 years)	60%
3.	3 Towns WS Feasibility Study	F/S	Dangla, Kobo Sekota	54,526	(mln birr) KFW : 2.0 TGE : 0.5 Total 2.5	Feb. 1996 - Aug. 1996	
4.	12 Towns WS Expansion & Rehabilitation	Expansion & Rehabilitation	*3	326,623	(mln birr) KFW : 16.4 TGE : 13.9 Total 30.3	1993 - Dec. 1995	70%
5.	2 Towns WS Project	Construction	Assela, Shashemene	102,531	(mln birr) IBRD : 31.0 TGE : 18.3 Total 49.3	Sep. 1994 - Sep. 1996	
6.	Ghimbi & Woldia WS Project	Construction	Ghimbi, Oromia	23,674	(mln birr) ADB : 7.3 TGE : 6.3 Total 13.6	1991 - 1995	95%
7.	7 Towns WS Project	Construction	Gonder, Bahir Dar, Nazareth, Mekele, Dessie, Gore, Zeway	518,918	(mln birr) ADB : 80% TGE : 20% Total 340.7	1996 - 2000 (4 years)	
8.	3 Towns WS Project	Construction	Limugenet, Bonga, Arsirobe	41,925	(mln birr) : 70% TGE : 30% Total 35.8	1996 - 1998 (2 years)	
9.	Adwa WS Project	Construction	Adwa	20,860	(mln birr) ORET : 60% TGE : 40% Total 46.4	1996 - 1998 (2 years)	
10.	Axum & Lalibela WS Project	Construction	Axum, Lalibela	54,188	(mln birr) ORET : 60% TGE : 40% Total 43.2	Jan. 1996 - 1997 (2 years)	

Notes: *1 = Adigrat, Indasellasse, Maichew, Asaita, Dabat, Addis Zemen, Fenote Selam, Debark, Koladiba, Dembidolo, Gebreguracha, Holeta Genet, Sebeta, Shambu, Fitche, Kibre, Mengist, Degahabour, Kebridehar, Alaba Kulito, Butajila, Dilla, Wolkite, Assosa, Gambella, Harar

*2 = Debre Birhan, Agaro, Bedele, Arsi Negele, Bale Robe, Asebe Teferi, Meki, Metehara, Awash, Gode, Harar, Mizan Teferi

*3 = Dangla, Kobo, Ghion, Ginir, Hagere Hiwot, Metu, Nekempt, Awassa, Hosaena, Yirgalem, Jijiga, Axum

IBRD = International Bank for Reconstruction Development, TGE = Transitional Government of Ethiopia, ADF = African Development Fund, KFW = Kreditanstalt fuer Wiederaufbau (Germany), ADB = African Development Bank, ORET = (Netherlands)

Source: Planning and Programming Department, WSSA

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. The urban percentage includes those with very low levels of services. 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.

The existing financial policy for water supply is not adequate. Current tariff rates are not based on cost recovery and as a result, there is hardly any room for rehabilitation and expansion of the schemes. Actual investment for water supply are far below requirements particularly when the overall water supply coverage is taken into consideration.

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. The pit latrines that are being used are usually filled up in 2-3 years. The owners that do have space available dig new pit latrines. Those who can afford to pay for a vacuum truck to empty them can do so if they can arrange to get vacuum truck from the nearest big city. Those who can not dig new ones due to lack of space and those that can not empty them, do not have other alternative except for resorting back to open-field.

Even if an arrangement is possible to get vacuum truck to empty pit latrines, there is no properly prepared sludge dumping sites in almost all rural centers. Dumping is done anywhere near the outskirt of the town; and this usually creates disputes between the municipality of the center and people living nearby the dumping sites.

In practically all centers, dry solid wastes and sullages are generally dumped anywhere along the streets and in open spaces available, thereby creating 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%.

Ethiopia was ruled by successive monarchs until 1973 when the last monarch was deposed in a coup. A military government was formed and followed socialist development policies. This government (the Derg) ruled from 1974 to 1991. After years of internal conflict, the war ended with the establishment of the Transitional Government of Ethiopia. The last government was replaced by a decentralized system comprising 10 regions created on the basis of nations/nationalities. 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. This Government has now been elected as the Government of Ethiopia.

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 anum) with nearly half of the population under 15 years. This is putting pressure on the productivity of the land, exacerbating the already high level of rural underemployment (estimated at 40%). Urban centers are growing more rapidly than rural populations mainly from the influence of migration from rural areas. Wars and famines in recent years have influenced the redistribution of the population further, including demobilization of 400,000 soldiers (many of them disabled and with dependents) and an estimated 1.5 million refugees from Sudan and Somalia. Currently there are a higher proportion of women headed households and orphans living in urban centers than in rural areas.

There are many interesting social factors. They include:

1.5.1 Education

During the Derg regime, school enrollment increased. This is now declining and is currently around 30% of all children. The enrollment of girls is lower than for boys (39%). The drop out rate and repeater rate for girls is higher than for boys, partly due to early marriage and domestic labor. Schooling is more widely available in urban than in rural areas.

1.5.2 Health indicators

Infant and under five year child mortality rates are high at 110/1000 live births and 161/1000 live births respectively. Diarrhoeal disease is a major cause of mortality and morbidity. As many as 46% of all childhood deaths have been attributed to diarrhoeal diseases (UNICEF, 1993). The case fatality rate especially in malnourished children is

extremely high. This situation is associated with a low daily calorie intake of some 1621 calories (30% below the required amount per capita) and poor levels of access to water and sanitation facilities. A reported lack of sufficient health and hygiene awareness contributes to the high incidence of water and sanitation related diseases including cholera. Unfortunately the previously established network of community health workers and traditional birth attendants are no longer supported and many no longer function.

1.5.3 Gender roles

Within basic family units, gender roles practiced by men and women lead to a division of labor. In most low income households, women undertake the responsibility for child rearing, and domestic chores including water collection, waste disposal and collecting wood. Women are often secondary income earners, either as agricultural laborers or in cotton spinning and handicraft production. In addition women have a community management role based on provision of goods for collective consumption. Men have the role of primary provider for the family, for decision making in the home and for leadership of the wider community. These roles are installed at an early age. At birth there is boy preference and during childhood boys will help their fathers while girls help their mothers with cooking, fetching water and handicraft work. Female circumcision and early marriages for girls (at 8-12 year) have been linked to the depression of the status of women. A National Policy on Ethiopian Women was adopted in 1993 to improve the situation women find themselves in and to encourage their participation in development (Lukach Haile, 1993)

1.5.4 Social Structures

Many Ethiopians participate in indigenous associations. In urban areas the EDER is a form of welfare organization functioning to help with funeral costs, to assist families in the event of loosing the income of their primary breadwinners and to help alleviate loss due to fire. Male members of an EDER are obliged to contribute to a common fund and to attend the funerals of other members. Female members are expected to assist with cooking and domestic preparations for funerals and other social activities. Rural people also have social organizations for instance cooperative work systems where labor can be exchanged to overcome shortages during peak agricultural seasons. The commitment to such organizations has always been deep and long-lasting, and any development initiative should take into consideration the role that these traditional organizations perform.

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 GDP of the country grew during the nine years from 1983/1984 to 1992/1993 by 21.1% at the average annual rate of 2.2%. During the same period, population increased by 32.7% from 39.5 million to 52.4 million at the average annual rate of 3.2%. It means that the per capita GDP decreased by 8.7% at the average annual rate of 1.0%.

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, this sector grew at the average annual rate of 2.1% which is at the parallel pace with the whole economy.

The tertiary sector was placed second with the share of 35.2% in the total DGP. Specifically, "Public Administration & Defense" took the largest share of 27.1% in this sector, followed by "Trade, Hotels & Restaurants" with 22.7% and "Transport and Communication" with 16.5%. These three sub-sectors accounted for two-thirds of this sectoral GDP. During the nine year period, this sector grew at the average annual rate of 2.9% which is at a pace faster than the whole economy.

The secondary sector accounted for 11.0% of the total GDP. "Manufacturing" and "Construction" were the two major sub-sectors occupying 37.7% and 23.6%, respectively, of this sectoral GDP. During the afore mentioned period, this sector virtually did not grow at all.

Summing up the above analysis, it can be said that Ethiopia is a predominantly agricultural economy and the government has been trying to keep that way. One thing to be noted in this regard is that the growth of the agricultural sector is out-paced by that of population. Further, it can be observed that the secondary sector's position in the economy is low, and it has not improved at all for the last decade. Especially, "Manufacturing", which is the engine for economic growth accounted for only 4.1% of the national GDP.

The GDP deflator rose at the average annual rate of 8.3% during the nine year period (Refer to Table 1.6.1).

Table 1.6.1 Structure and Trend of National Economy of Ethiopia (Unit : birr million at 1980/81 factor cost)

Sector	83/84	84/85	85/86	86/87	87/88	88/89	89/90	90/91	91/92	92/93
Primary	5,185	4,113	4,776	5,661	5,517	5,545	5,840	5,984	5,867	6,241
- Agriculture	4,513	3,475	4,066	4,935	4,777	4,790	5,069	5,200	5,067	5,421
- Forestry	669	634	706	722	736	751	767	780	795	815
- Fishing	3	4	4	4	4	4	4	4	5	5
Secondary	1,244	1,300	1,381	1,493	1,442	1,390	1,329	1,084	1,002	1,273
- Mining and Quarrying	19	25	24	25	20	20	19	52	39	57
- Manufactoring	491	470	517	573	596	593	570	349	316	480
- SSI & Handicrafts	219	203	234	255	235	212	234	202	202	237
- Electricity and Water	130	136	147	164	164	171	175	180	187	198
- Construction	385	466	459	486	427	394	331	301	258	301
Tertiary	3,145	3,232	3,333	3,676	3,864	3,918	4,119	3,594	3,457	4,081
- Trade, Hotels & Restaurants	1,020	963	952	1,175	1,190	1,066	1,142	786	684	927
- Transport & Communication	439	477	534	542	580	598	590	547	609	675
- Banking & Insurance	223	266	252	310	371	342	332	297	310	306
- Real Estate & Ownership of Dwelling	266	276	286	295	304	316	330	342	353	367
- Public Administration & Defense	743	792	822	852	933	1,053	1,148	986	842	1,106
- Education	204	210	213	220	228	243	249	271	279	271
- Health	75	79	82	87	88	92	94	91	100	115
- Others	175	169	192	194	170	208	234	274	280	314
Total	9,574	8,645	9,490	10,829	10,823	10,853	11,288	10,662	10,326	11,595
Population (million)	39.5	40.7	42.1	43.5	44.8	46.2	47.6	49.2	50.8	52.4
Per capita GDP (birr)	242.4	212.4	225.4	248.9	241.6	234.9	237.1	216.7	203.3	221.3
GDP at current factor cost (birr million)	9,917	11,980	12,433	13,186	13,617	14,379	15,514	17,508	19,416	24,537
Per capita GDP at current factor cost (birr)	251.1	294.3	295.3	303.1	304.0	311.2	325.9	355.9	382.2	468.3
GDP Deflator	100.0	133.8	126.5	117.6	121.5	127.9	132.7	158.5	181.5	204.3

Source : National Bank of Ethiopia

Chapter 2 General Description of the Study Area

2.1 Natural Condition

2.1.1 Topography

Ethiopia is a country of great geographical diversity with high and rugged mountains, flat topped plateaus, deep gorges, incised river valleys and rolling plains as shown in Figure 2.1.1. Altitudes range from the highest peak at Mt. Ras Dejen (Siemen Mountains), 4,620 m.asl, down to the Danakil depression at Lake Asele, about 110 m below sea level.

The country is broadly divided into three major geographic regions : 1) the Western Highlands and associated lowlands, 2) the South Eastern Highlands and associated lowlands, 3) the Rift Valley running from the northeast to the south in the middle of the country and separating the Western Highlands and the South Eastern Highlands. Among the Eleven Centers, nine in 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 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 2,000-2,500m 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 is rather narrow in the south, but in the northeast, it funnels out in the Afar plain. The Amhara 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.

2.1.2 Geology

In Ethiopia, the Palaeozoic and Mesozoic rocks unconformably overlie the basement which is the Precambrian with ages of over 600 million years, and further, these rocks are unconformably overlain by the younger rocks which consist of the tertiary volcanics and the Quaternary sediments and volcanics (refer to Figure 2.1.2).

The Precambrian is composed of a wide variety of sedimentary, volcanic and intrusive rocks which have been metamorphosed to variable degrees. They are exposed in the south and west of Ethiopia, and in the part of Tigray Province to the western Eritrea. The Precambrian in south and west, where granitic rocks and gneisses predominate, has been more strongly metamorphosed than the Precambrian sequence in the north, which have generally undergone only weak metamorphism, reflecting the relatively low temperatures, though in many cases strongly folded and foliated.

Palaeozoic rocks, shales and glacial origin deposits, are locally exposed in the north of the country. Mesozoic rocks, which mainly consist of shallow marine sedimentary rocks as conglomerates, sandstones, mudstones and shales with interbedded marls and limestones, widely predominate in the Ogaden area and in the area along the Abay River.

Extensive fracturing occurred in the early Cenozoic, and then major displacement along the fault systems of East African Rifts occurred in the late Tertiary. Faulting was accompanied by widespread volcanic activity which led to the formation of vast quantities of basalt lava over the western half of the country. This was accompanied by, and alternated with, the eruption of large amounts of ash and coarser fragmental material, forming the Trap Series. Volcanism has persisted to the present in the Afar Region at small eruptive centers. The composition of Quaternary volcanic lava ranges from basalt to siliceous types. The youngest sediments composed of conglomerate, sand, clay and reef limestone accumulate in the Afar Depression. The adjacent area of Dupti and Mille is dominated by the Quaternary lava and alluvial and aeolian deposits along the Awash River.

2.1.3 Climate

Ethiopia lies in the low latitude zone (3°N to 18°N latitude). There are two pronounced seasons annually, the dry season and the rainy season. However, as it is a highland country with topographical diversity, tropical climatic conditions are not experienced everywhere and rainfall is seasonable, varying in amount, space and time as shown in Figure 2.1.3. For instance, tropical temperature conditions are limited to the lowlands in the Rift Valley and the peripheries, in summer (June-September), there is a long and heavy rain called Keremt, under the influence of the southwest equatorial westerlies in the whole country with the exception of the northern tip. In spring, autumn and winter (October-May) there are short and moderate rains called Belg, further, southwestern Ethiopia receives rain twice a year, which does not coincide with the periods of Keremt and Belg.

The climate in Ethiopia is broadly classified into three major climatic regions;

- Tropical Climate
  The mean temperature of the coldest month is above 18°C and mean annual rainfall is between 680 and 2,800 mm. This climate prevails up to an elevation of 1,750 m.asl.

- Arid and Semi-Arid Climate
  In this region, mean annual rainfall is less than 800 mm and evaporation exceeds rainfall.

- Warm and Cool Highland Climate
  The mean temperature of the coldest month is below 18°C and the mean annual rainfall is between 800 and 2,000 mm.

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.

Figure 2.1.1 Topographic Map of Ethiopia

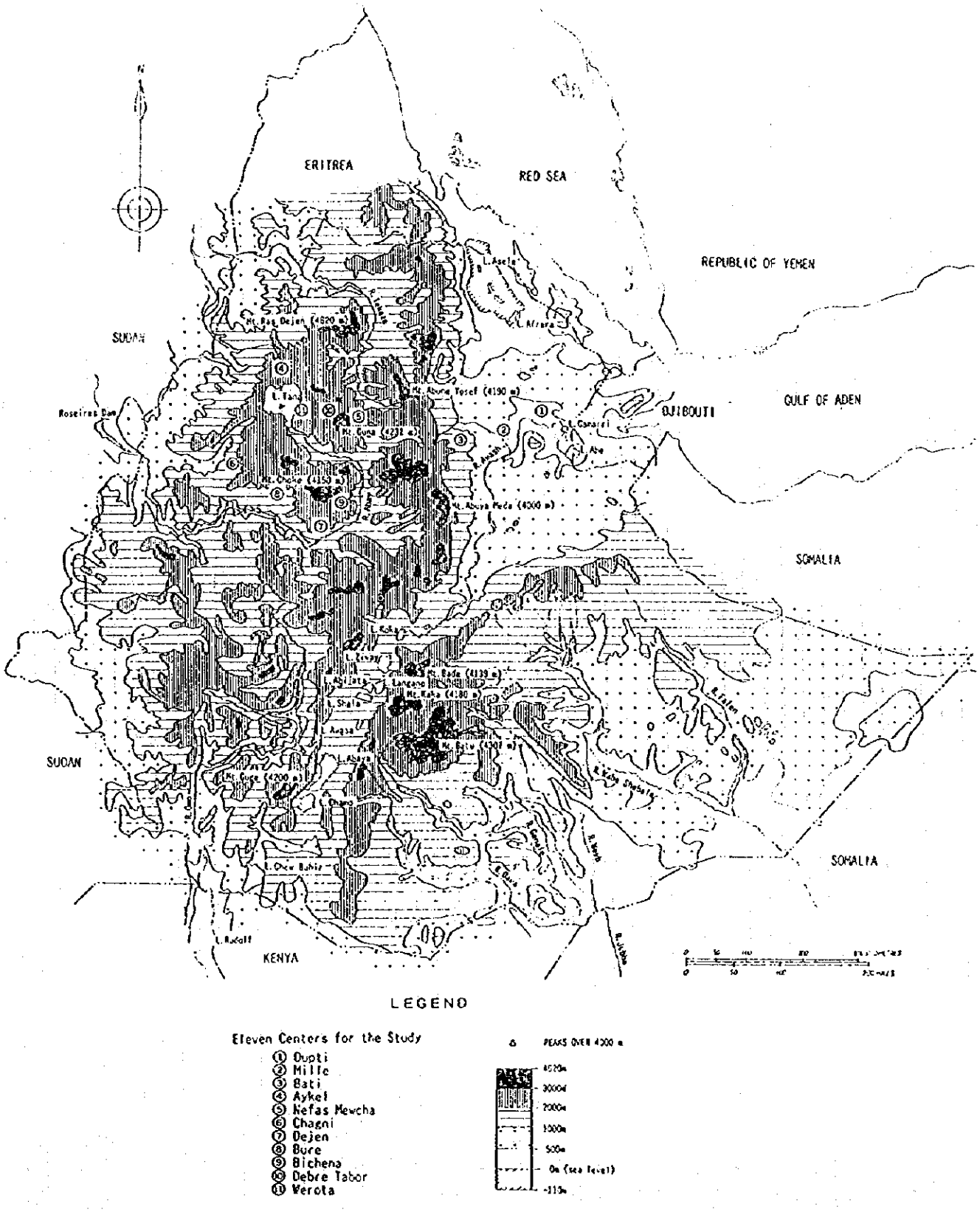


Figure 2.1.2 Geological Map of Ethiopia

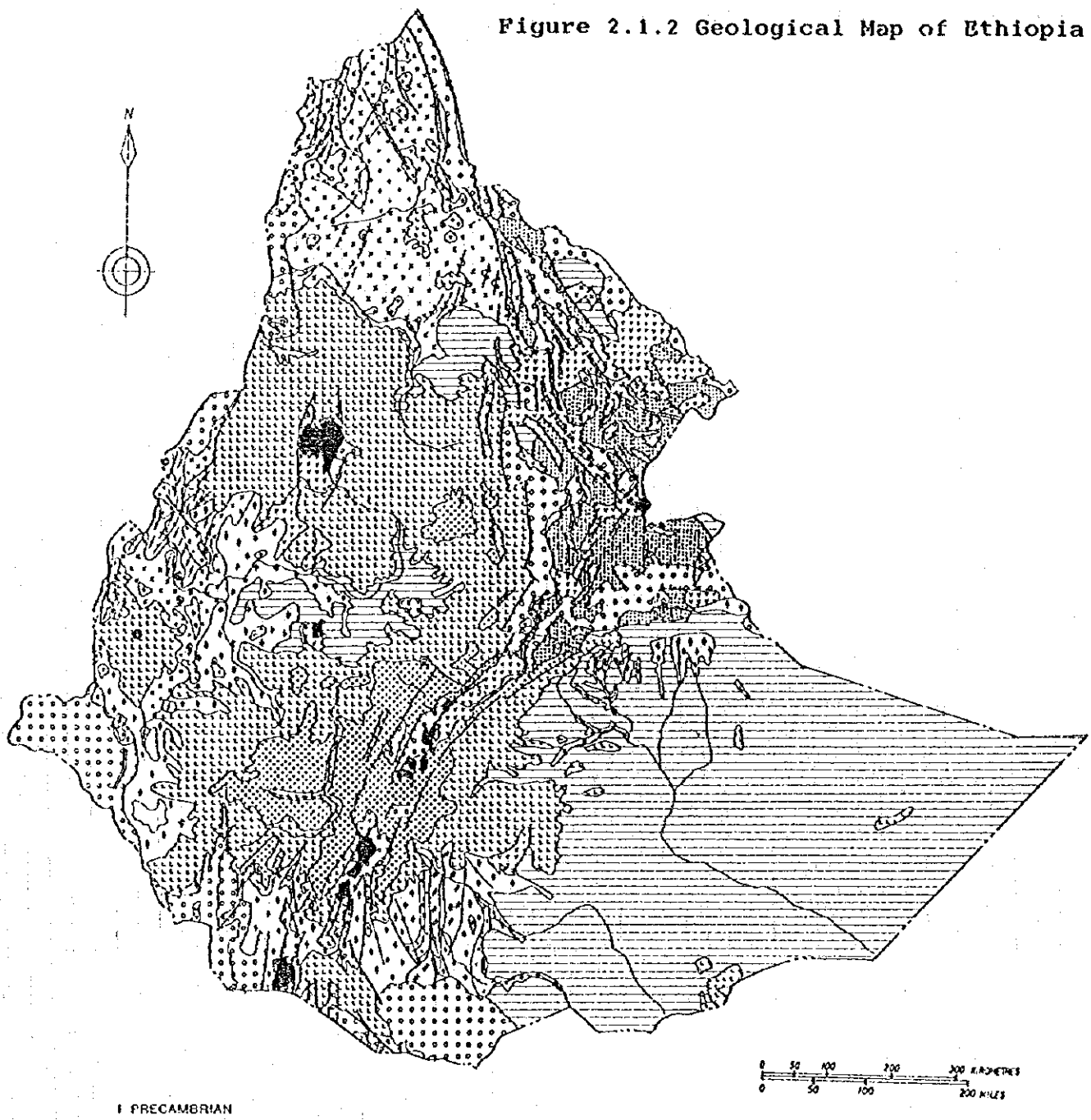
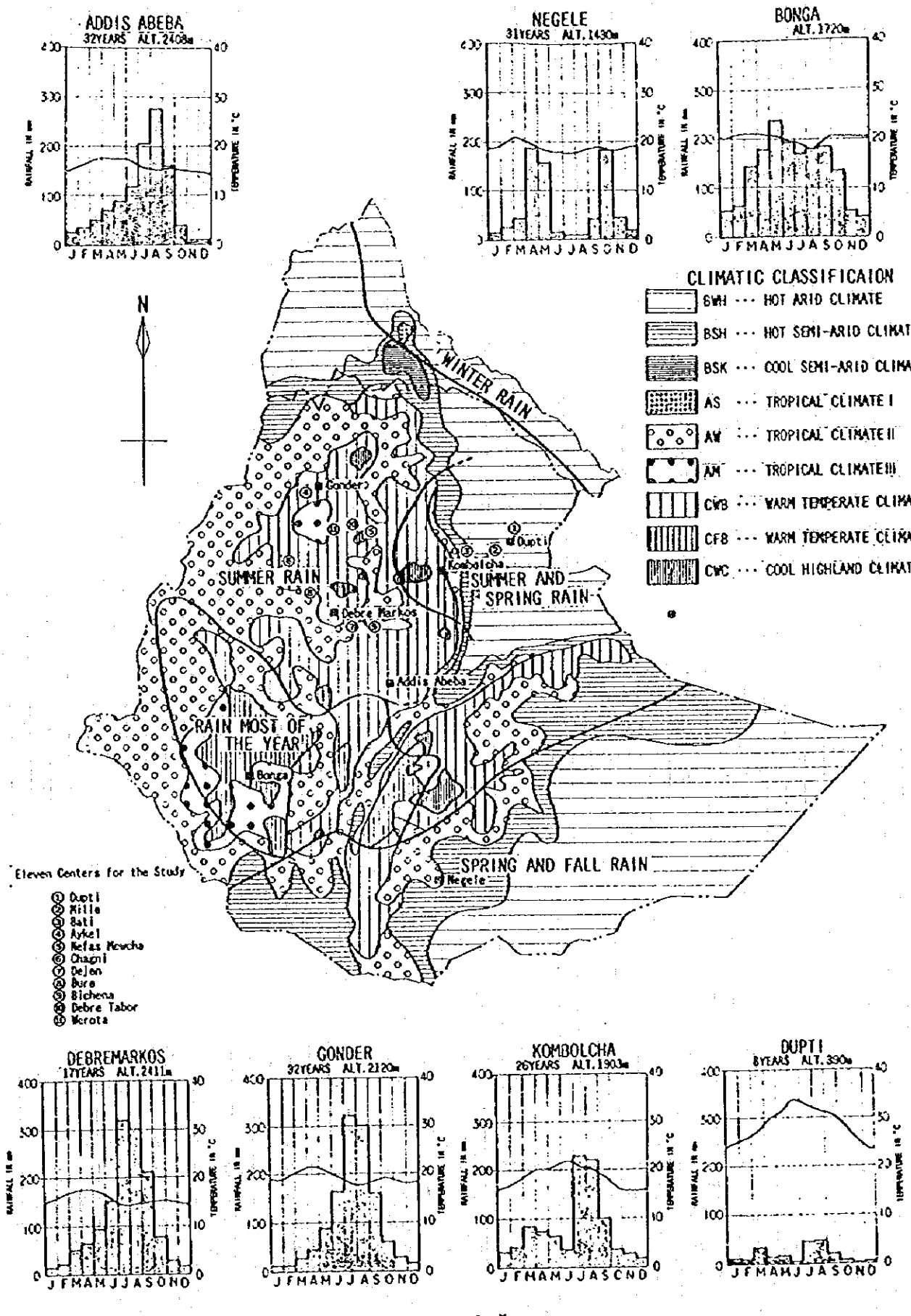


Figure 2.1.3 Climatic classification Map



2.2 Social and Gender Situation

Afar Region has a strong Muslim influence which determines the societal roles. However, in the hottest areas these codes tend to be more relaxed than in cooler areas. Work patterns are different to those in the highlands as there is a siesta period for four hours during the hottest period of the day. The month of Ramadan falls in February. During this time Muslims go without food or water during daylight hours and tend to feast at night.

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. Livestock is the backbone of the economy. Population density is low and extensively dispersed.

Afar depends on livestocks for their livings, and they tend to resist settlement and are thus poorly represented in Eleven Centers in this region, namely, 6% in Dupti, 4% in Mille and 13% in Bati according to the result of household survey carried out in this Study. Government policies which attempted to settle nomadic groups or to convert dry season grazing areas into commercial plantations and national parks have adversely affected nomadic societies. The growth of agriculture due to increased population pressure has also changed the pastoral land regimes. The relationship between nomadic societies and the government have been marked by mutual incomprehension. 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 settles 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).

Previous studies of urban areas in these two regions have not been carried out. The study therefore has little information with which to compare the results. The most problematic area for collection of data related to social and gender was the access and control profiles. People were not willing to divulge such information readily either in a mixed group, in single sex groups or at household or individual level. This type of information had to be roughly generated. With project implementation and familiarization with project staff, individuals may be more prepared to discuss these matters. However the Study indicates that access and control of resources in Male Headed Households is shared between the

male and female partners equally particularly for items like latrine construction. They consider money and resources to be a "shared pot" for the household.

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. The results of the household survey show that Muslim households tend to be poorer than Christian households and that women headed households, particularly Christians households, have more households with low incomes than male headed households (See Figure 2.2.1). With their additional roles and lower incomes it is likely that female household heads are excluded from wider community leadership roles and will be under represented at this level. There is a higher ratio of female household heads in Christian areas than in Muslim area (See Figure 2.2.2). This may add to under representation of women in these communities.

Figure 2.2.1 Income related to Religion and Gender

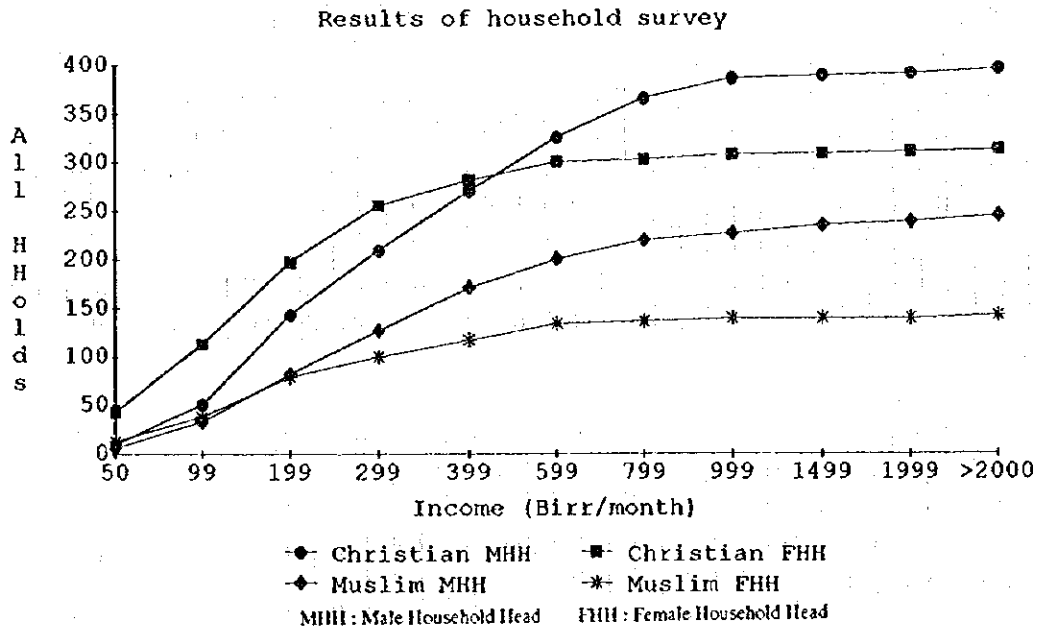
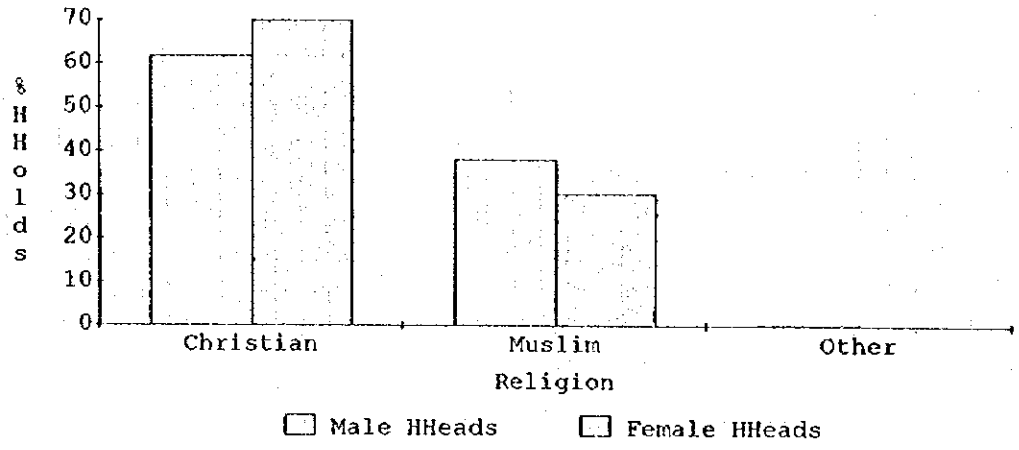


Figure 2.2.2 Religion and Gender of Household Heads

Results of Household Survey



2.3 Economic Situation

The average 1995 population of the Eleven Centers concerned works out to 15,664. Chagni has the largest population of 26,823, while Mille has the smallest population of 3,902.

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%).

Commerce includes retail/wholesale trade and service industry. Retail/wholesale trade consists of selling of livestock such as oxes, cows, sheep, goats, donkeys, mules and horses, agricultural crops such as wheat, tef and barley, maize, sorghum, beans and peas, fruit, vegetables and household items. They also sell local drinks. Service industry consists of hotels, restaurants, bars, tea rooms, tej houses, etc.

Cottage industry consists of flour mills, oil factories, manufacturing of leather and leather products, handicraft and others. The share in the total workforce is minimal (0 to 2%) except in Dupti where it occupies 8.2%. It is noted that there is Tendaho Agricultural Development Enterprise where they produce cotton.

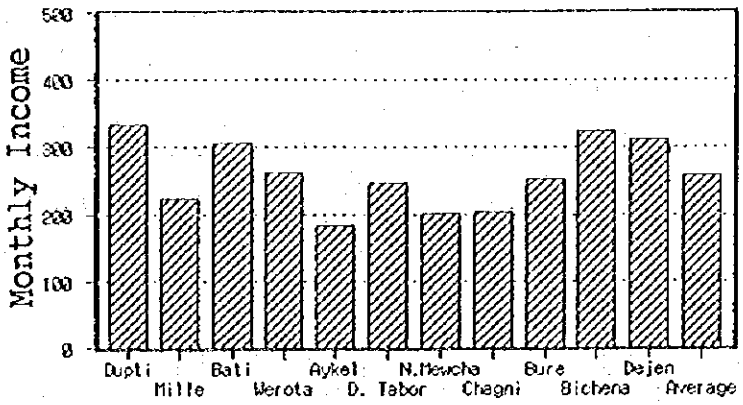
The price of animals per head ranges from less than 100 birr to more than 1,000 birr depending on the type of animals. The price of grains/beans is more or less 200 birr per 100 kg.

Average monthly salaries of a government employee work out to 346 birr. They are not so much different between the Centers. Day laborers earn five to 10 birr per day.

The average monthly household income of the Eleven Centers is calculated at 259 birr (refer to Figure 2.3.1). 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.

Figure 2.3.1 Average Household Incomes in Eleven Centers



2.4 Town Planning and Power Supply

2.4.1 Town Planning

The master plan for town planning and the topographic maps for Eleven Centers were collected by the Team. However, of the Eleven Centers, those for Mille and Dupti were not available. The master plans collected were formulated during the era of the Imperial Government as shown in Table 2.4.1, while the topographic maps were prepared on the basis of aerial photos taken in the following years:

Table 2.4.1 Master Plan & Aerial Photo

Center	Year of master plan formulated	Year of aerial photo taken
Bati	1967	1972
Werota	1981	1972
Aykel	1974	1972
Debre Tabor	N.M.	1968
Nefas Mewcha	1972	1979
Chagni	1966	N.M.
Bure	1972	1971
Bichena	1982	1973
Dejen	1977	N.M.

N.M. : Not mentioned.

In addition to above, the present situation of the master plan on the town planning was also confirmed by the Team at the regional and zonal offices of Public Works and Urban Development Bureau (PWUDB).

According to the officials in charge of town planning, those existing master plans for above nine centers are still being applied to date. However, 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.

The areas which are being developed presently shall be served with the piped water system under this Project.

2.4.2 Power Supply

Electric supply in Ethiopia has been managed and controlled by Ethiopian Electric Light and Power Authority (EELPA). Generally, electric power in Ethiopia is supplied by either hydroelectric power or off-site generator. The future extension plan is now under formulation in EELPA. The present power source and the tentative extension plan are summarized as follows:

Table 2.4.2 Power Supply Situation

Center	Present power source	Expected year of hydroelectric supplied
Dupti	Diesel generator	within Year 2005
Mille	-do-	no plan
Bati	Hydroelectric	-
Aykel	Diesel generator	within Year 2005
Debre Tabor	Hydroelectric	-
Nefas Mewcha	Diesel generator	within Year 2005
Werota	Hydroelectric	-
Bichena	-do-	-
Bure	-do-	-
Chagni	Diesel generator	no plan
Dejen	-do-	within Year 1997

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 future, such as Dupti, Aykel, Nefas Mewcha, and Dejen shall have the hydropower as the source of the water supply when the electric power is shifted to the hydropower.

Chapter 3 Comprehensive Evaluation and Proposed Measures Based on Present Situation

3.1 Water Resources

3.1.1 Present Conditions

The existing water sources in Eleven Centers are divided into two; namely, groundwater and spring. The sources were tabled below with those numbers.

Table 3.1.1 Water Source in Eleven Centers

Center	Water Source	Number of Water Source	Remarks
Dupti	Groundwater	2	Afar Region
Mille	-do-	2	-do-
Bati	-do-	4	Amhara Region
Werota	-do-	1	-do-
Aykel	Spring	1	-do-
Debre Tabor	Groundwater	3	-do-
Nefas Mewcha	-do-	1	-do-
Chagni	-do-	1	-do-
Bure	Spring	2	-do-
Bichena	Groundwater	1	-do-
Dejen	-do-	1	-do-

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, the sand and gravel aquifer is confined by the impervious clay layer, thus recharge does not occur in the area. Therefore, water of the aquifer has high concentration of salinity.

In the centers on the Abisinian plateau, the basement is composed of basalts, which are weathered and partly covered by pyroclastics at the surface. The basalts are usually not permeable but they become permeable where they are fractured or fissured. Therefore faulted zones and fractured zones are the target aquifers in the plateau. Most of the deep wells have the yield between 1.0 l/s and 3.0 l/s with the drawdown between 5 m and 15 m.

Because of very small water watershed area per well (0.5 - 3 km^2) in Debre Tabor and Nefas Mewcha located on the hilltops, overpumping is a serious problem, which causes lowering of the static water level significantly 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).

Taking the above conditions into consideration, it is important to evaluate not only the yield of the wells (springs) but also the recharge to the aquifers in quantity in the Abisinian plateau.

3.1.2 Proposed Measures

Followings are the proposed sources for the Project:

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

Since Dupti has a water quality problem with the water from the deep wells, which is rich in minerals, salts and fluoride, shallow aquifers existing near Awash river is to be developed because the aquifers are replenished by the river and the water quality is expected to be better than the water of the existing deep wells. The water from the shallow wells dilutes the water from the deep wells and it is distributed by the water supply system.

Bure has a water quality problem as well with the water of deep wells, which is rich in minerals and carbonated, while steam water is clean during dry seasons and the water is not utilized at moment. The Study Team built a gauging station on Manzana stream in May, 1995. However, the record of the discharge is short and thus the feasibility was not determined yet. In terms of ground water development, three (3) deep wells are proposed, which are located in the east and the north in the area. Since the total yield of the wells and the existing WSS springs is less than the maximum day demand of year 2005 and the demands of year 2010, it is proposed to continue the study for other sources including Manzana stream and the spring near Edget Behibret elementary school.

3.2 Water Quality

Water quality analysis has been made in both physico-chemical and bacteriological aspects, using calorimetric, volumetric analysis and filtration technique methods respectively. In the operational procedure and application of guideline value, "WHO Guidelines for Drinking-Water Quality 1993" has been referred to, and the bacteriological aspect is presented as the number of faecal coliforms detected in the water.

The samples for the analysis had been collected at the sources which were operated by WSS or Water Committee, and the results are shown in Table 3.2.1. Also, additional samples were collected from some supplemental water sources such as spring, river and hand dug well. Besides those samples for the sources, many other samples had been collected and undertaken for bacteriological test, those of which were from reservoir, private and yard connection, public fountain and household containers, in order to identify the place(s) of bacteriological contamination taking place.

Table 3.2.1 Water Sources and Their Quality

Center	Water Source & Number	Chemical Aspects	No. of Faecal Coliform/100ml
Dupti	Groundwater: No.2	Na^+,F^-,Fe^- above	2
	(2 wells) No.4	Na^+,F^-,Cl^- above	-
	Borehole No.1	Na^+,Cl^-,NO^{3-},F^- above	-
	Russian camp	F^-,SO_4^{--} above	-
	Tendaho	CL^-, SO_4^{--} above	-
	RRC	$SO4^{--}$ above	-
	Awash River*1	Color, Turbidity	
Mille	Groundwater: No.1	Acceptable	1
	(2 wells) No.2	Acceptable	3
Bati	Groundwater: No.1	Acceptable	3
	(4 wells) No.2	Acceptable	-
	No.3	Acceptable	0
	No.4	Acceptable	0
Werota	Groundwater: No.1	Acceptable	0
	(1 well)		
Aykel	Spring : No.1	Acceptable	TMTC*3
	(1 spring)		
Debre Tabor	Groundwater: No.1	Acceptable	0
	(3 wells) No.2	Acceptable	0
	No.3	NA*2	-
Nefas Mewcha	Groundwater: No.1	Acceptable	0
	(1 well)		
Chagni	Groundwater: No.1	Acceptable	0
	(1 well)		
Bure	Spring : No.1	Acceptable	0*4
	(2 springs) No.2	Acceptable	
Bichena	Groundwater: No.1	Acceptable	-
	(2 wells): No.2	Acceptable	-
Dejen	Groundwater: No.1	Acceptable	0
	(1 well)		

Note: *1 Awash River is acceptable for drinking except color and turbidity.
*2 Borehole No.3 is expected to start in November, 1995.
*3 TMTC means too-many-to-count.
*4 The sample was collected at collecting chamber.

3.2.1 Physico-chemical Aspects

All samples, which had been collected from the sources of WSS or Water Committee and then undertaken for the physico-chemical test, showed that the analyzed constituents were within the acceptable range in accordance with the WHO guideline, with exception of Dupti's. On the other hand, some samples collected from supplemental sources showed that such constituents as color, turbidity, nitrate and iron were above the guideline value. These results are shown in Appendix-2.

(1) Results of Dupti

In Dupti, five samples had been undertaken for physico-chemical test during this Study. Among those, four samples are groundwater including from the source of WSS Borehole No.2 and one sample is surface water collected from Awash River. Also, results tested by Ministry of Health are referred to in line with those obtained by the Team. The samples carried out by the Ministry are from Borehole No.1 located near a mosque at the center of the town, Borehole No.4 (another source of WSS, started functioning in April 1995), and Borehole No.2 same as the borehole tested by the Team.

Those representative constituents, which are above WHO drinking water quality guideline values, are summarized below. The first five samples were tested by the Team and the last three samples by the Ministry of Health. The population of Dupti are served piped water by the Borehole No.2 and No.4 currently.

Table 3.2.2 Summary of Chemical Aspects in Dupti

Place	Sodium	Iron	Chloride	Nitrate	Fluoride	Sulfate	Remarks
Borehole No.2	-	2.20*	215.0	0.40	2.10*	2.1	JICA
Russian camp	-	0.13	125.0	1.76	1.70*	475.0*	JICA
Tendaho	-	0.01	375.0*	2.20	1.34	900.0*	JICA
RRC	-	0.01	150.0	4.84	1.37	500.0*	JICA
Awash River	-	0.30	35.0	33.40	0.67	15.0	JICA
Borehole No.1	550.8*	0.14	382.9*	88.60*	2.50*	248.5	May '93
Borehole No.4	347.0*	0.06	269.4*	1.00	1.90*	141.6	
Borehole No.2	380.8*	0.24	249.6	2.30	2.10*	178.0	Apr '93
WHO guideline	200.0	0.30	250.0	50.00	1.50	250.0**	

Note: * The value is above the WHO guideline.
** Value set in 1993 guideline (400 in 1984 guideline).
Borehole No.2 & No.4 are the source of WSS.
Unit is mg per litre unless otherwise stated.

Although sodium concentration had not been tested for the samples collected by the Team, the groundwater indicates high concentration of sodium according to the results obtained by Ministry of Health. The WHO guideline says there is some evidence that drinking water with moderate sodium levels (100mg/l) may be associated with an elevation of blood pressure in children. However it is unknown that if the small blood pressure increases are significant in terms of the development of early hypertension. At present, there is

insufficient evidence to justify a guideline value for sodium in water based on health-risk considerations. However, it can be said that the intake of sodium may be of great significance for persons suffering from hypertension or congestive heart failure.

Iron content of 2.2 mg/l detected for Borehole No.1 is above the guideline value. Although high iron content gives no harmful effect for health, this causes stain in laundry and sanitary ware and an undesirable taste in beverages. The presence of high concentration of iron may also lead to deposits in water distribution pipes and increase maintenance cost.

Three samples from Tendaho Plantation borehole, Borehole No.1 and No.4 show chloride concentration of 375, 383 and 269 mg/l respectively, which are above the guideline value of 250 mg/l. High concentration of chloride gives an undesirable taste to water and beverages, and the taste thresholds is experienced in the range of chloride ion concentration of 200 to 300 mg/l. High concentration of chloride is also known to be corrosive to metals in the distribution system, and may suggests the water is salty. According to the medical doctor of Tendaho Plantation Hospital, kidney problem probably associated with the salinity was reported to be ranked at 6th among the top ten diseases in the hospital record.

The nitrate concentration in the sample from Borehole No.1 is 88.60 mg/l, while the WHO guideline recommends the value of 50 mg/l. Since the well is located at almost center of the town, it is expected that the well is probably contaminated with sewerage and/or body disposal discharged from the residential area. Although the borehole is not serving for the population, excessive amount of nitrate in drinking water causes methaemoglobinaemia in bottle-fed infants in most cases and occasionally in some adults.

Fluoride problem is well known in Rift Valley area. WHO guideline sets the fluoride value at 1.5 mg/l, and at levels above the 1.5 mg/l, mottling of teeth has been reported very occasionally. Table 3.2.2 carries such five samples collected from four places with values of between 1.7 and 2.5 mg/l above the guideline value, each of which are from Borehole No.2, Russian Camp borehole, Borehole No.1 and Borehole No.4 respectively. In physical observation carried out in February 1995, between 40 to 50% of children had been found with mottling of their teeth. Since Dupti is very hot place, their water consumption must be more than that of other centers. This gives more effect of fluoride to the population and a scheme be introduced to avoid the fluoride problem. On the other hand, there were much less adults observed with the mottling teeth because they used to drink Awash River's water which contains less fluoride as shown in the Table 3.2.2.

Except Borehole No.1, No.2 and No.4, other three samples of groundwater show high concentration of sulfate; namely 475 mg/l in Russian Camp, 900 mg/l in Tendaho, and 500 mg/l in RRC, while the guideline value is set at 250 mg/litre. Sulfate generally has less effect on taste than chlorides. The taste thresholds vary according to the associated cation, and it has been reported to range from 250 for sodium sulfate to 1,000 mg/l for calcium sulfate (Generally taste impairment is minimal at levels below 250 mg/l). It is also known that high sulfate concentration shows laxative effect specially for new users and children. In addition, metal corrosion may be increased.

(2) Results of Bure

The analyzed parameters for the source (spring No.1&No.2) are within the acceptable range set by the WHO guideline, while the sample collected from Manzana River shows that color, turbidity and total iron content are above the guideline value. Although Manzana River is expected as one of new water sources, the iron content of 7.55 mg/l against 0.3 mg/l set by the guideline stains laundry and plumbing fixtures and causes an undesirable taste in beverages.

Samples from the artesian well located beside mineral water factory show that the chemical constituents are above the guideline values in terms of total dissolved solids and total hardness as well as iron, copper and nitrate, and thus the water is highly mineralized and very hard water.

(3) Nitrate in Bati, Werota and Debre Tabor

Nitrate detected in samples collected at Bati, Werota and Debre Tabor is 98.56 mg/l, 61.16 mg/l and 114.40 mg/l respectively against the WHO guideline value of 50 mg/l. The samples from Bati and Werota were collected in a spring on which few people depend, while the sample from Debre Tabor was collected in a hand dug well among those wells on which about half population of the town depend.

As mentioned before, the nitrate concentration is probably associated with the pollution of fertilizer, sewerage and body disposal discharged from the residential area. When nitrate present in excessive amounts in water, it indicates that the pollution occurred could not have been recent since nitrate is the final oxidation product of the element nitrogen. Although no case of methaemoglobinaemia has been reported, it is recommended that the springs and wells be abandoned for drinking purpose and the users be introduced into the service of WSS water.

3.2.2 Bacteriological Aspects

(1) Water Supply System

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 (see Appendix-2). 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. In Aykel, proper sanitary inspection of the source and occasional chlorination must be employed or alternate source of groundwater, if available, be introduced which is free from the contamination.

Since the samplings were made in occasional basis, it cannot be ensured the sources in Dupti, Mille and Bati are continuously contaminated, vis-a-viz, other sources except Aykel are somehow free from the contamination. However, it is probable that the distribution water can be easily contaminated because most water supply systems are not kept pressure continuously, thus bacteria infiltration can be taken place. Also, as the systems are aged, the contamination is expected in such way of through cross-connections, back-siphonage,

leaking and defective storage reservoir. In fact, 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. This confirms that the contamination of the potable water from the source takes place through poor sanitary condition accompanied with leakage and/or infiltration along the distribution system.

Since chlorination into water supply system is not practiced except Bure at present, such disinfection scheme must be employed at least in occasional basis, in line with rehabilitation of the existing facilities.

(2) Household Container

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 (see Appendix-2). 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.

To facilitate the household level sanitary improvement, bleaching agent (the available chlorine content is 4 to 6%) had been tried in Werota for the chlorination of the household clay pot with different dosages. The dosages ranged 10 to 50 ppm, those of which can be practically employed in the household level. The result suggests that the bleaching agent is not enough to disinfect the coliforms inhabiting the clay pots, though clay pots which had shown too-many-to-count faecal coliforms before the disinfection became to be countable for the coliform with the effect of the bleaching agent.

There is an interesting indication from the result obtained in Nefas Mewcha. No coliform was detected for the samples collected from the source as well as its outlets such as public fountains and private connections. The protected spring (Zenti) had been tested twice, both of which showed no faecal coliform. Likewise, water fetched from those sources and stored in household containers showed no coliforms with some exceptions. The outcome based on above suggests that bacteria especially the thermophilic one cannot be well developed in the distribution lines and containers under such low temperature caused by high altitude with about 3,000m (water in a clay pot showed 17°C dated June 21, 1995), if the water source is properly protected from unhygienic condition and free from the bacteria.

3.3 Water Collection, Consumption and Demand

3.3.1 Water Collection

In the Study, information from the household survey about who collects water from the various sources is shown in Figures 3.3.1, 3.3.2 and 3.3.3. 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. In

Aykel and Chagni, boys spend a significant amount of 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 then women and girls are the primary target group with men being target groups in Mille, Dupti and boys being additional target groups in Aykel.

Data made available through the household survey demonstrates differences by gender of household head for source availability. Figures 3.3.4 and 3.3.5 show that there is a variation between the sources of water available to men and to women headed households. This is summarized for each available source in Figure 3.3.6. These figures show that 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.

Although incomes for Christians on average are higher than those for Muslims, there seems to be some variation in the level of water supply service enjoyed by the two religious groups. Figure 3.3.7 shows that more Muslim households enjoy PCs while more Christians use PFs. There seem to have been very few Muslim households using Private or Public wells, but the small sample size may account for this anomaly. No cultural reason for this was identified. The number of vendor users is larger in Muslim religious group, and proportionally more Muslims rely on other sources.

Figure 3.3.1 Water Collection by Gender and Age

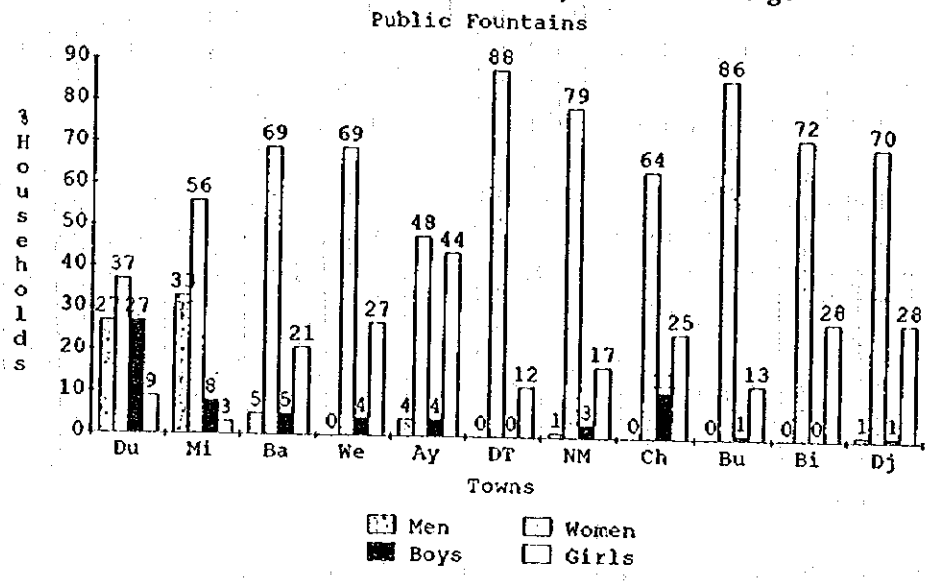


Figure 3.3.2 Water Collection by Gender and Age

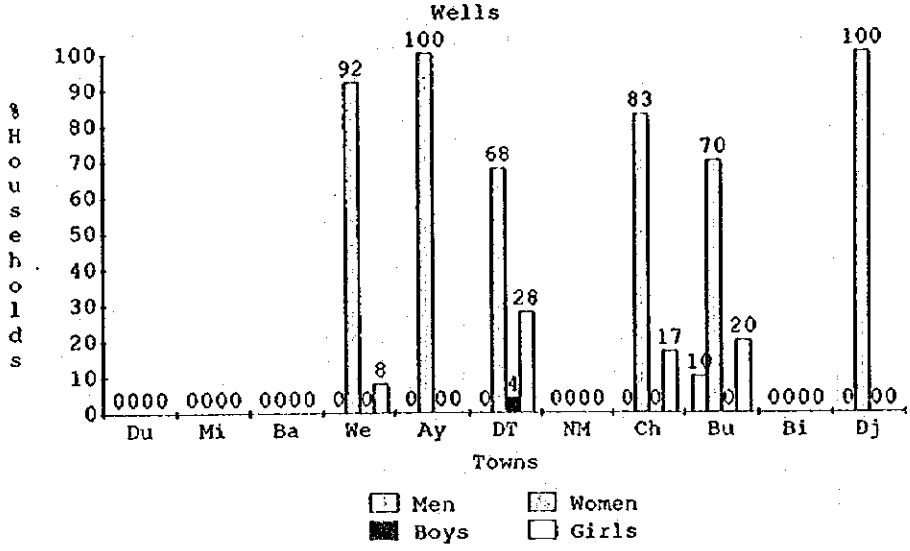


Figure 3.3.3 Water Collection by Gender and Age

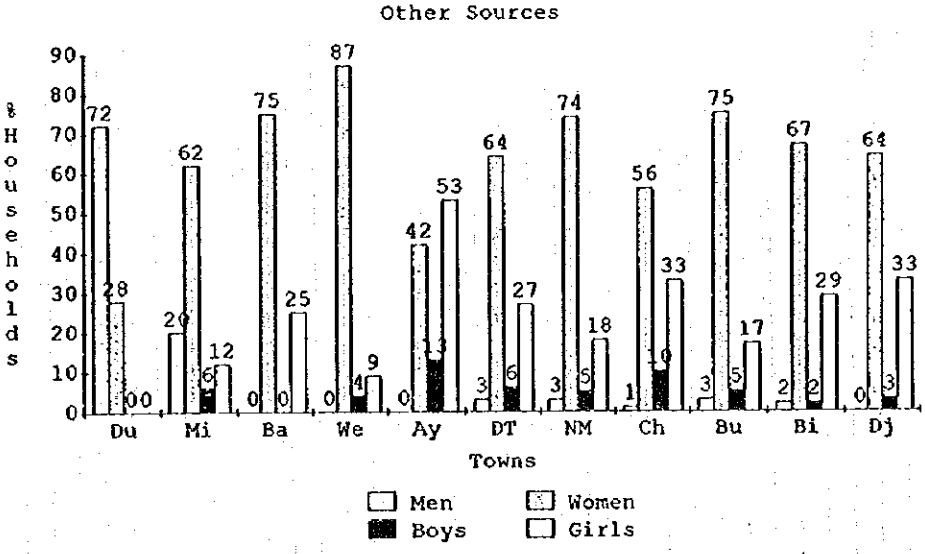


Figure 3.3.4 Sources for Male Headed Households

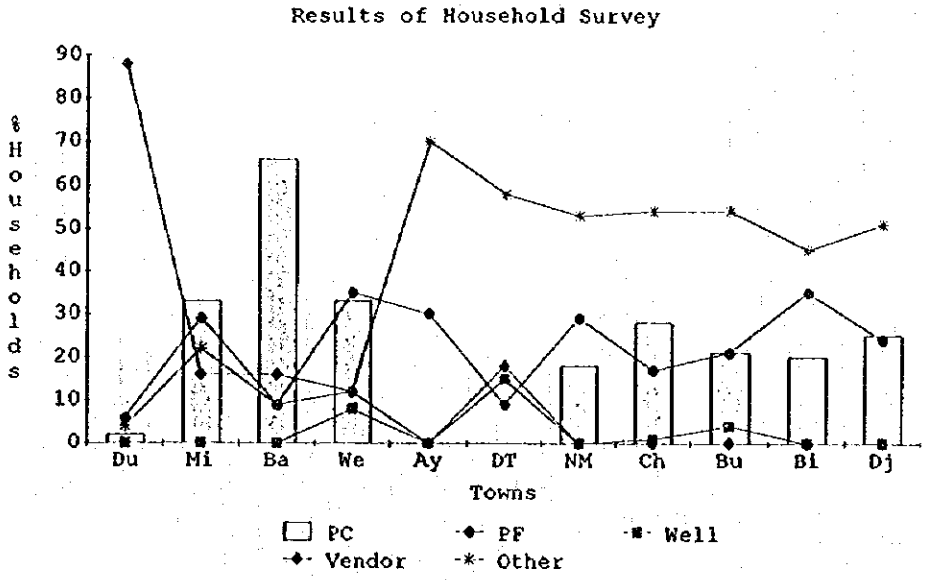


Figure 3.3.5 Sources for Female Headed Households

Results of Household Survey

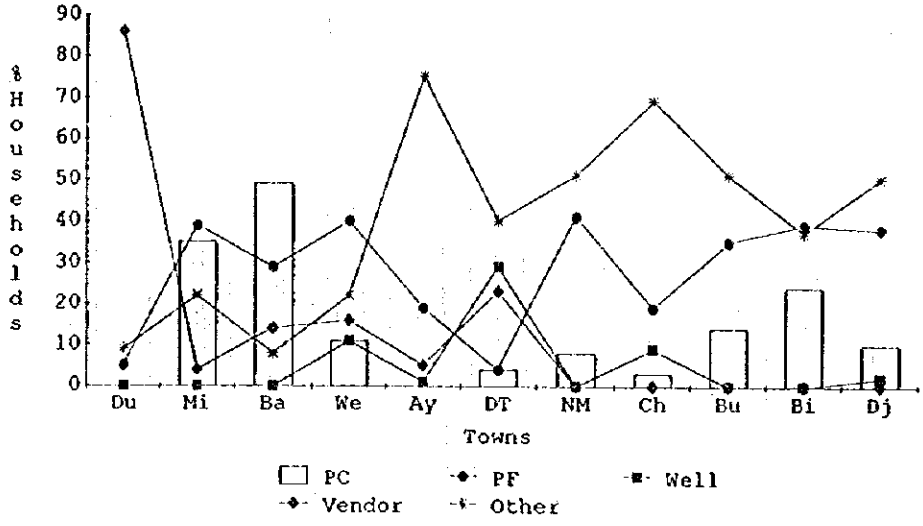


Figure 3.3.6 Sources Used by Households

Gender taken from Household Survey

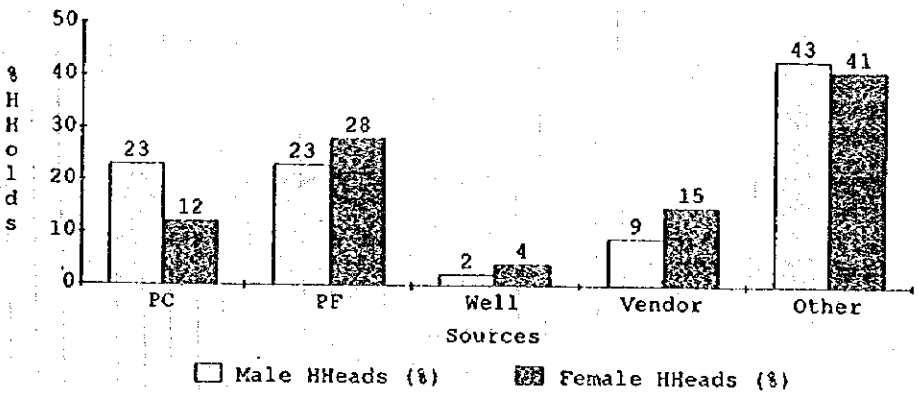
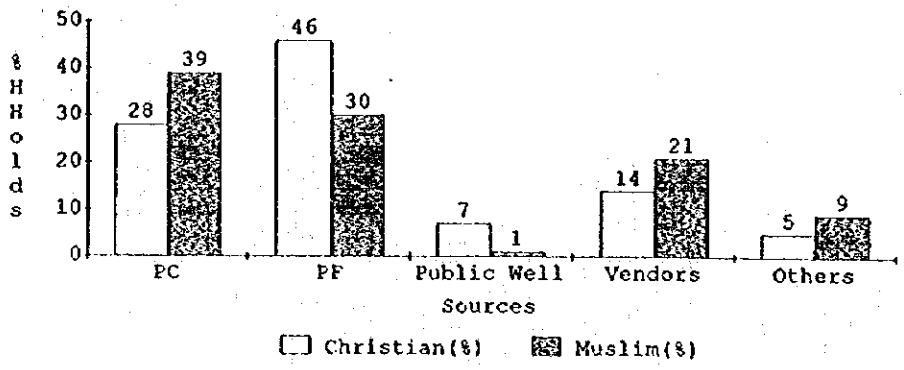


Figure 3.3.7 Sources Used by Households

Religion taken from Household Survey



3.3.2 Water Consumption and Demand

The following surveys have been carried out on water demand and supply in this Study:

- Sample survey as 100 household questionnaire interviews,
- Consumption and demand census covering all population,
- Analysis of water production/consumption provided by WSS, and
- Review of water analysis sheet provided by WSS.

The findings obtained through the above surveys are described below.

(1) Water Service Coverage

Based on the water consumption census and the data obtained at WSS offices in the Centers, the percentage of the population served is obtained as shown in the following:

Table 3.3.1 Population Served in Eleven Centers

Center	Total Population	Served Population	Percentage (%)
Dupti	14,737	6,614	44.9
Mille	3,902	3,795	97.2
Bati	14,354	12,494	87.1
Werota	21,845	21,014	96.2
Aykel	11,718	8,329	71.1
Debre Tabor	25,575	8,578	33.6
Nefas Mewcha	13,726	12,705	92.6
Chagni	26,823	12,375	46.1
Bure	14,745	12,226	82.9
Bichena	14,629	9,768	66.8
Dejen	10,250	8,507	83.0

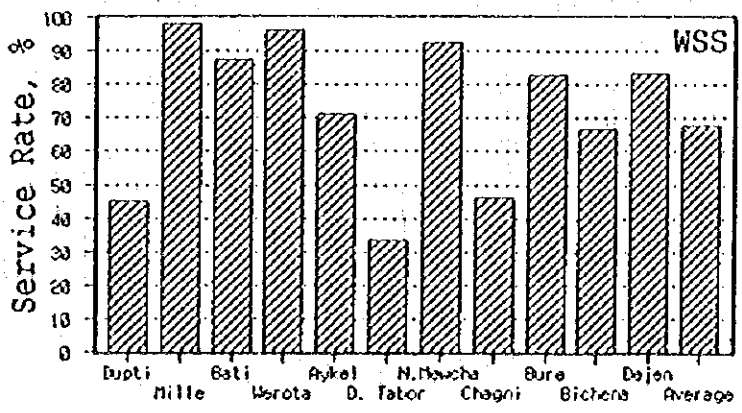


Figure 3.3.8 Comparison of Water Service Coverage among Eleven Centers

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, Nefas Mewcha, Bati, Dejen, Bure, Aykel, Bichena, Chagni, Dupti 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.

(2) Service Mode

The 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 or piped water. Neighborhood tap users are the ones who do not have such private connection, thus depend on mostly neighbor's yard connection.

Public fountain users are divided into two; namely, 1) people who live in outskirt of the town and have difficulty for the access to the piped water, and 2) people who cannot access the piped water due to low income.

Traditional source users depend on mostly hand dug well or spring other than the source of WSS.

The percentages among those WSS's service modes such as HC, YC, NU and PF are summarized in the following, and the results show that there are few household connection users while the majority depends on public fountain. Also, the number of neighborhood users cannot be neglected as the user seems to be almost same as yard connection users in the number.

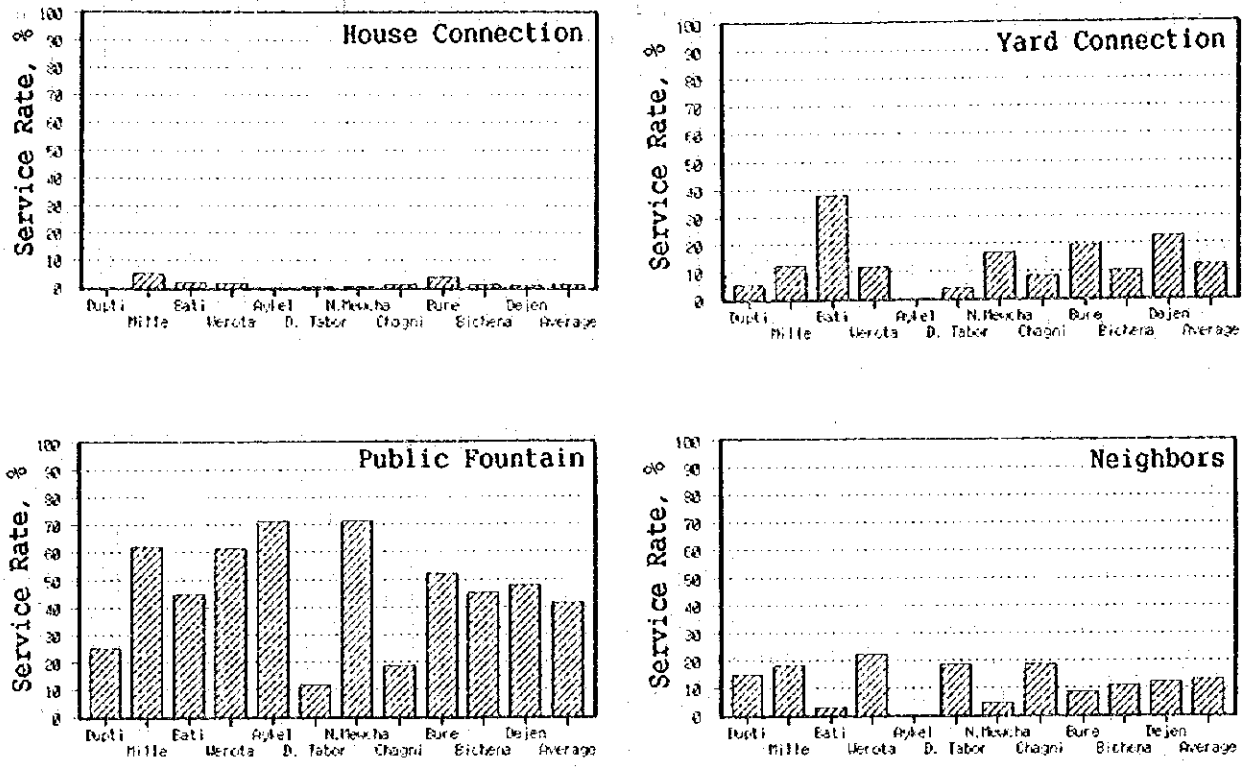


Figure 3.3.9 Comparison of Water Service Mode among Eleven Centers

(3) Water Consumption and Demand

With reference to the water users category mentioned above, water consumption (liter per capita per day) and their demand are summarized in Table 3.3.2. These were identified by the water consumption and demand census survey inclusive of demand of traditional source users. In summarizing the consumption and demand, if the demand was obtained lower than actual consumption, the consumption was adopted as the demand because it was expected to have been caused due mainly to limited number of the sampled.

Based on the results, the followings are obtained:

- 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.

It is also expected that the current demand may be conservative ones due to the long standing experience of inadequate water supply.

Under such condition, people cannot stop depending on other water sources such as private vendors, user's own or public hand dug wells, rain water harvesting and springs. Thus, the present status of water supply in Bleven Centers is critical and need to be improved urgently.

Table 3.3.2 Water Consumption and Demand per Capita per Day

	Dupti	Mille	Bati	Werota	Aykel	D. Tabor	N. Mewcha	Chagni	Bure	Bichena	Dejen	Average
House C.		83.4	48.8	28.6		16.0	38.1	63.8	23.6	26.4	56.6	42.8
(lpcd)		83.4	56.6	32.9		30.9	38.1	63.8	25.0	26.7	56.6	46.0
Yard C.	61.0	38.9	26.2	39.1		14.1	16.6	32.4	25.0	22.0	21.0	29.6
(lpcd)	64.0	60.0	47.5	39.1		28.6	27.8	32.4	25.0	22.0	23.1	37.0
Neighbors	20.2	23.0	15.0	8.8		2.3	8.0	7.4	10.4	7.9	9.1	11.2
(lpcd)	47.0	46.0	38.0	27.8		27.3	25.8	25.0	18.9	18.9	20.1	29.5
Public F.	6.7	6.8	6.1	1.5	2.3	2.3	1.6	4.9	4.6	4.7	4.9	4.1
(lpcd)	33.0	32.0	26.0	23.8	15.1	24.4	22.3	23.2	16.4	17.5	16.7	22.8
T.S.U.												
(lpcd)			23.5	22.2	13.1	23.4	21.0	21.8	10.3	13.8	12.1	17.9

Note: Upper figure is consumption and lower is demand.
T.S.U. means traditional source user.
lpcd means liter per capta per day.

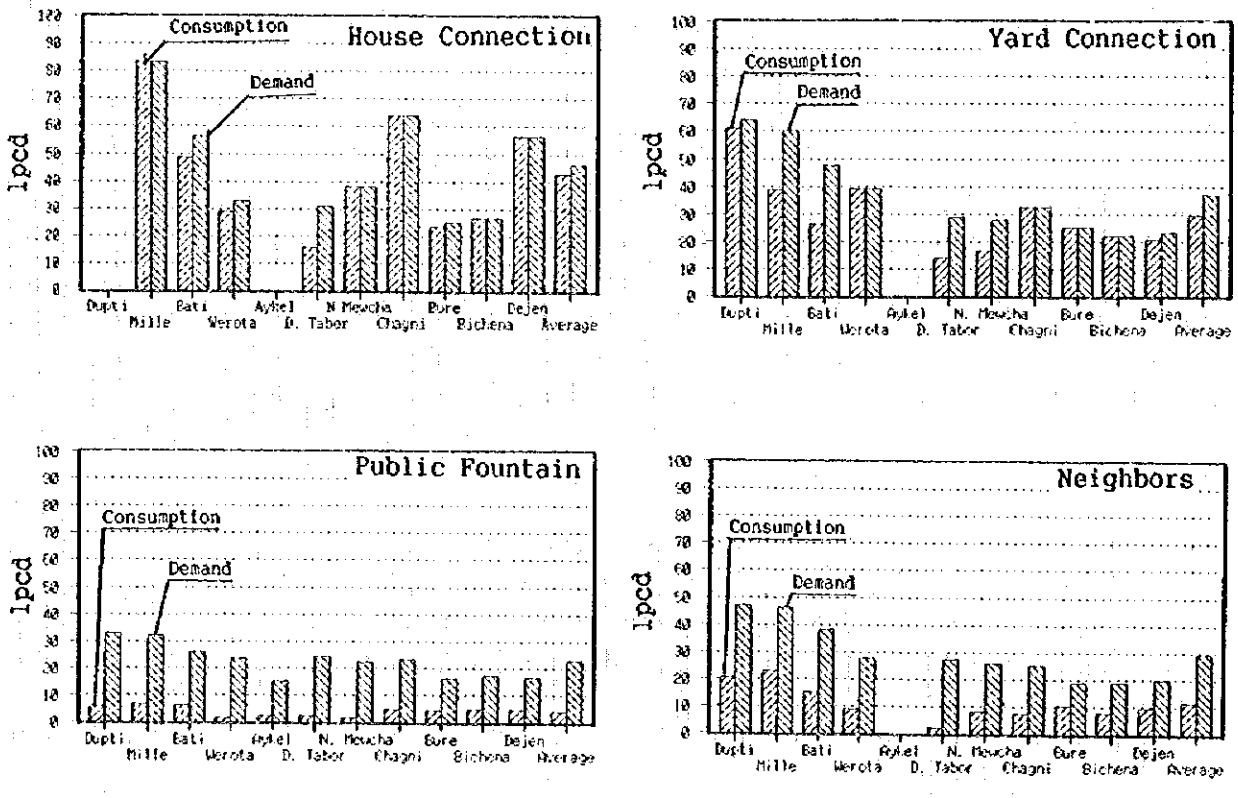


Figure 3.3.10 Consumption and Demand by Service Mode among Eleven Centers

3.4 Water Supply Facilities

Survey for water supply facilities has been carried out in such manners as physical investigation, pulling-out some pumps in Dupti, Bati and Dejen, and analysis of data/information collected. The findings and problems identified are described as follows.

3.4.1 Water Source

The existing water sources in Eleven Centers are divided into two sources: namely, groundwater and spring. These sources are summarized in the following table with the number and the equipped pump facilities. Submersible pump is employed in the source of deepwell, and mono-pump is utilized in the spring of Aykel. In Bure, no pumping facility is equipped with the springs, and the collected water is directly delivered to the collecting chamber by gravity.

Table 3.4.1 Water Source Data in the Eleven Centers

Center	Water Source	Number of Water Source	Pumping Facilities
Dupti	Groundwater	2	Submersible Pump
Mille	-do-	2	-do-
Bati	-do-	4	-do-
Werota	-do-	1	-do-
Aykel	Spring	1	Submersible Pump
Debre Tabor	Groundwater	3	-do-
Nefas Mewcha	-do-	1	-do-
Chagni	-do-	1	-do-
Bure	Spring	2	without pump
Bichena	Groundwater	1	Submersible Pump
Dejen	-do-	1	-do-

Problems on the present water source are as follows:

- The number of boreholes is scarce to meet the water demand of the population,
- The construction level, especially finishing, is low, so that it is difficult to carry out observation works such as measuring static and dynamic water level. Thus, it is difficult to study the potentiality of groundwater.
- There is no borehole equipped with a complete set of the air pressure and flow meter for the pump. Thus, it is difficult to observe whether the borehole pump works properly or not.
- It is expected that the existing submersible pumps in the most of the Centers are aged, though the time elapse after setting the pumps has not been recorded.

3.4.2 Power Source

Existing water supply system is operated by either hydroelectric power or on-site generator. The system in Bati and Werota only are driven by hydroelectric power, and the latter has a stand-by generator. The remaining ones are operated by on-site generator.

The common problems on the power supply facilities are as follows:

- Centers, where the water supply system is operated by on-site generator, do not have standby generator, thus operation hours of the generators are limited due to the cooling, and

- 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.

3.4.3 Transmission and Distribution System

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 common problems on transmission and distribution facilities are summarized as follows:

- The distribution network is not expanded enough to meet present development of the Centers,

- Some houses have been built on the existing pipeline route, so it is impossible to replace the pipeline when necessary.

- There are many places where the pipeline is exposed because of low covering depth of the pipe. Thus, the pipeline is easy to be damaged.

- The capacity of the service reservoirs is insufficient to store water against the current demand which has been enlarged due to population growth. All existing service reservoirs are not equipped with the water level indicator,

- The existing valve box has no cover in most places. The inside of the box contains sand or garbage, and it makes difficult to carry out the valve works, and

- Water supply system in all Centers is not equipped with disinfection system except Bure, for which occasional chlorination has been carried out into the collecting chamber.

3.4.4 Service Level

The present service level is divided into three modes: house connection, yard connection and public connection.

Problems on the service level are identified as follows:

- Public fountain is limited in terms of the operation because of insufficient water and lack of attendant, thus fetching water at public fountain is restricted, and

- Few number of households have managed to change from low service mode to high; namely, public fountain to yard connection and then house connection, due to the scarce water supplied and insufficiency of the distribution network.

- The number of water meter stocked in WSS office is too small to lend to the users. Thus, the situation of service level can not be improved.

3.4.5 Operation and Maintenance

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 in the WSS offices.

Maintenance work and other major works such as installation of pipes, generator,etc. are done by Water Supply Section of the Regional Office.

No regular check-up for the existing facilities has been made so far, though the inspection tour is carried out by O & M crew in the Regional Office once a year.

The problems on O & M are as follows:

- Skilled technician and mechanic are not stationed in the Center, nor available in the Region,

- Design drawings, as-built drawings, specifications of mechanical equipment are not kept in any office, even at the central level. Thus, specifications of pumps installed are not clear,

- Workshop for maintenance in the Regional office is insufficient to manage in terms of lack of technical staff and equipment,

- Existing equipment was purchased from various countries such as Italy, India, Japan, Denmark, etc. This makes difficult to keep compatibility among those facilities, and

- It is difficult for WSS office to purchase even small equipment such as water meter, pressure gauge, etc. due to financial constraint.

3.4.6 Proposed Measures

In order to secure stable and safe water supply, the following measures are proposed in the Project.

(1) Water Supply Systems

Proposed measures for water supply systems are as follows:

- Construction of new borehole(s) to meet the water demand,
- Rehabilitation of the existing boreholes; namely, replacement of aged existing pumps, refinish of borehole, and installation of necessary instrument such as flow meter, air pressure valve, etc.,
- Replacement and expansion of existing reservoir to secure the necessary storage capacity for the demand, and expansion of the existing distribution network,
- Facilitation of disinfection system, and
- Reinforcement of public fountains.

(2) O & M

Proposed measures for O & M are as follows:

- Reinforcement of existing O & M section in Regional Office, and reinforcement of workshop in WSSs to carry out the works,
- Establishment of training center in the Regions to improve the skill of technicians, mechanic and electrician. Otherwise, Regional office dispatch the staff to the existing training course held in Arba Minch Institute of Water Technology, and
- Securing the compatibility of spare part, and purchase of the equipment from certain countries.

3.5 Sanitary Facilities Condition

3.5.1 Toilet Facilities

A population and housing census has been carried out in 1984 and analytical report has been issued by the office of the Population and Housing Census Commission in 1990 and updated in 1993. The report included the 1984 urban sanitation for the whole country where all Eleven Centers are covered except for Mille and Aykel. The distribution of housing unites or households is made by:

- Type of toilet facility used,

- Type of material used in the construction of walls, roofs and floors, and
- Shower facilities.

These are shown in Tables 3.5.1 and 3.5.2. Table 3.5.1 reveals that households without any form of toilet facility range from 33% to 79%. Dupti is the one where the 33% of the housing units do not have toilet facilities; whereas Bichena has the highest percentages of 79% of housing units that do not have toilet facilities. In descending order, Werota has 78%; Dejen 77%; Bure 69%; Nefas Mewcha 66%; Debre Tabor 63%; Bati 62% and Chagni 50% of housing units that do not have toilet facilities, indicating a very large size of population living in these centers defecate in the open field. This clearly shows how grave the sanitation situation is in these centers in the past.

Considering dry pit toilet, both private and shared, the table shows that the housing units in Dupti have the highest percentage 56%; Chagni the second highest 48%; Debre Tabor the 3rd highest, 36%; whereas Werota has the lowest 16% followed by Bichena and Dejen each having 19%.

Table 3.5.1 Distribution of Housing Units by Type of Toilet in Eleven Centers (After 1984 Population and Housing Census and as updated in 1993)

Urban Center	Number & Percent	Type of Toilet Facility						
		Flush		Dry pit		None (Open-field)	Other	Total
		Private	Shared	Private	Shared			
1. Dupti	No.	174	89	661	665	776	17	2,382
	%	7.3	3.7	27.8	27.9	32.6	0.7	100.0
2. Mille	No.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
3. Bati	No.	47	8	358	343	1,333	50	2,139
	%	2.2	0.4	16.7	16.0	62.3	2.4	100.0
4. Werota	No.	80	0	153	150	1,503	44	1,931
	%	4.1	0.1	7.9	7.8	77.8	2.3	100.0
5. Aykel	No.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
6. D/Tabor	No.	27	1	770	381	2,033	17	3,229
	%	0.8	0.1	23.9	11.8	63.0	0.5	100.0
7. N/Mewcha	No.	1	-	234	144	827	32	1,249
	%	0.9	-	18.7	11.5	66.2	2.7	100.0
8. Chagni	No.	9	4	319	502	859	19	1,712
	%	0.5	0.3	18.6	29.3	50.2	1.1	100.0
9. Bure	No.	41	3	367	157	1,281	22	1,871
	%	2.2	0.1	19.6	8.4	68.5	1.2	100.0
10. Bichena	No.	29	3	145	186	1,369	9	1,741
	%	1.7	0.2	8.3	10.7	78.6	0.5	100.0
11. Dejen	No.	32	9	168	117	1,174	19	1,519
	%	2.1	0.6	11.1	7.1	77.3	1.2	100.0

N.A. = Not Available

Table 3.5.2 Distribution of Housing Units by Type of Materials Used in the Construction of Walls, Roofs & Floor; and by Shower Facility in % (After 1984 Population and Housing Census and as updated in 1993)

Center	Wall			Roof		Floor			Shower Facility
	Wood & Mud	Stone & Mud	Stone & Cement	Corrugated Iron Sheet	Thatch (Grass)	Earth/ Mud	Cement/ Concrete	Wood Tile	
1. Dupti	84%	<1%	8%	15%	21%	79%	10%	6%	13%
2. Mille	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
3. Bati	90%	2%	3%	79%	16%	81%	7%	8%	3%
4. Werota	77%	4%	4%	61%	29%	88%	4%	5%	<2%
5. Aykel	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
6. D/Tabor	88%	6%	2%	85%	11%	92%	4%	1%	3%
7. N/Mewcha	94%	2%	2%	91%	5%	85%	<2%	10%	<2%
8. Chagni	89	1%	3%	69%	28%	91%	4%	2%	3%
9. Bure	94%	<1%	<2%	90%	7%	90%	4%	<2%	<2%
10. Bichena	97%	<1%	<2%	93%	5%	88%	9%	2%	2%
11. Dejen	84%	<3%	11%	89%	6%	82%	4%	6%	1%

N.A. = Not Available

Table 3.5.3 Distribution of Households by Type of Toilet Facilities Used (1995 JICA Household Survey of 100 Households in Each Center)

Center	Type of Toilet Facility						
	%	*Septic Tank	Dry Pit Latrine	Community Toilet	Open Field	Other	Total
1. Dupti	%	5	83	9	3	-	100
2. Mille	%	-	44	-	56	-	100
3. Bati	%	3	65	4	28	-	100
4. Werota	%	2	54	-	43	1	100
5. Aykel	%	-	36	2	62	-	100
6. D/Tabor	%	1	57	5	37	-	100
7. N/Mewcha	%	-	50	2	46	2	100
8. Chagni	%	1	56	1	42	-	100
9. Bure	%	-	57	-	43	-	100
10. Bichena	%	-	43	1	56	-	100
11. Dejen	%	-	46	6	48	-	100

* Flush Toilet

The urban population growth rate per year can be practically taken as 6%, while the households growth rate as about 4%, being slower than the population growth. The trend of increased households every year increases the need for more the already existing poor sanitary situation.

A general sanitation survey including 100-household-questionnaire survey, has been carried out in all Eleven Centers from March to July, 1995. The general observation is that the current sanitation condition is very bad in practically all centers. A majority of people use open field for excreta 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. The distribution of households by type of toilet facilities used based on the household survey in each center is shown in the Table 3.5.3.

From the result of the 1995, selected survey as depicted in Table 3.5.3, it can be generalize that more use of dry pit latrine has been made; and at the same time it can be noted that still many people in these centers defecate in open-field in comparison with the situation a decade ago (compare with Table 3.5.1).

Most of the pit latrines in almost all centers have foot-rests and practically none of them have covers for the squatting holes. These pit latrines are very badly used and unclean, and have considerable odours thereby encouraging the user to resort to open-field defecation.

Table 3.5.2 reveals the materials used in the construction of walls, roofs and floors of the housing units in the Eleven Centers. The most popular materials for constructing walls are wood & mud (stick & mud), corrugated iron sheets for roofs and earth & mud for floors. The popularity of these materials in all Eleven Centers is still maintained.

Accordingly, the superstructures of the toilet facilities generally follow the same pattern except for neglect of timely and proper maintenance.

When pit latrines are filled up, the majority of the owners either dig new pit latrines if they have space or resort to open-field disposal of excreta, thereby increasing the trend of open defecation. Those who can afford and can get vacuum truck to empty the filled-up toilets can do the emptying after a long wait due to non-availability of the truck on time. There are no properly prepared refuse disposal sites in any of the Centers.

Public toilets are practically non-existent in almost all the centers except for Bati, Aykel, Bure, Bichena and Dejen. The public toilets in Bati, Bure, Bichena and Dejen are completely filled up and have excreta all-over the places. These filled-up public toilet have very bad odours and they are no longer used.

The common problems on toilet facilities are summarized as follows:

- The toilet facilities in all centers is very bad practically due to lack of regular maintenance, so it is difficult to make the pit empty, and

- The number of vacuum track in the regional office is too small to take care of the toilet facilities in the whole centers of the region.

3.5.2 Dumping Site

During the survey of these 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 as show in Table 3.5.4. There are some that burn their refuse, especially Bati does this.

In practically all the centers, people dump their sullages along the streets, or on any open spaces they find including spaces in front of their houses. The results of the household survey reveals this situation in Table 3.5.5. Very few of them use pits to dump their sullages. Dupti is prominent on this, because people make use of the pits they have dug for the purpose of using the excavated material for covering their roofs for cooling purposes. The sullages that are being dumped along the streets and in front of the houses become so unhygienic and nuisances that they create health hazards especially to children that play nearby.

The common problem on dumping site is that the site is selected randomly because existing site for dumping is limited and far from the center.

3.5.3 Drainage Facilities

Very few of these centers have facilities for the drainage of rain water. The main streets in each center bisect the center. These main streets are usually constructed by the Ethiopian Road Authority (ERA) and they have proper side and cross drainages for the main road. Other streets or roads within the municipalities of the centers have proper neither rain nor wast water drainage facilities.

The common problems on drainage facility are as follows:

- Existing drainage facility for rain water is blockaded due to lack of regular maintenance, and

- There is no drainage facility for rain water for secondary and tertiary roads, and stagnations is created.

3.5.4 Proposed Measures

In order to remedy the deficiencies and to improve the bad sanitary conditions prevailing in almost all the centers, following measures are proposed;

- Introduce toilet facilities with simple physical features which can be copied by the users,

- Design the toilet with full use of local materials, which can be constructed by the users,
- Employ or get the users/communities involved into the construction stage so that they can be motivated or owner-sensed,
- Establish maintenance system by the user with the supervision of WSS and municipality,
- Provide vacuum tracks and refuse trucks with essential number of bins,
- Provide adequate sludge dumping sites agreed with surrounding people,
- Provide sullage disposal facilities to prevent or reduce environmental and health hazards,
- Provide adequate and functional drainage facilities to prevent formation of water stagnations and water ponds, and
- Rehabilitate and maintain the existing drainages.

Table 3.5.4 Response to Disposal of Solid Wastes of 100 Households

Center	%	Way of Disposal				
		Thrown Anywhere	In Open Pit	In Covered Pit	Burnt	Total
1. Dupti	%	38	38	6	18	100
2. Mille	%	69	8	0	23	100
3. Bati	%	30	7	1	62	100
4. Werota	%	88	5	2	5	100
5. Aykel	%	90	9	1	0	100
6. D/Tabor	%	70	18	3	9	100
7. N/Mewcha	%	62	24	3	11	100
8. Chagni	%	64	21	12	3	100
9. Bure	%	60	21	19	0	100
10. Bichena	%	68	22	3	7	100
11. Dejen	%	75	17	3	5	100

Table 3.5.5 Response to Disposal of Sullage (Waste Water) of 100 Households

Center	%	Way of Disposal				
		Any Where	Pit	Drain	Vegetable Garden	Total
1. Dupti	%	65	33	2	0	100
2. Mille	%	94	6	0	0	100
3. Bati	%	79	15	4	2	100
4. Werota	%	100	0	0	0	100
5. Aykel	%	100	0	0	0	100
6. D/Tabor	%	84	7	8	1	100
7. N/Mewcha	%	81	15	3	1	100
8. Chagni	%	61	10	15	14	100
9. Bure	%	82	13	4	1	100
10. Bichena	%	84	10	5	1	100
11. Dejen	%	82	4	13	1	100

3.6 Health and Sanitary Awareness

Levels of health awareness and incidence of disease are notoriously difficult to obtain with accuracy. The level of health and sanitary awareness reported varies within the same center with the different survey methodologies but is generally high. Results of the household surveys for each center for the knowledge about the preparation of oral rehydration solution (ORS) for people suffering from diarrehea, for the ways to prevent diarrhoeal diseases and also the general level of health awareness assessed during the group meetings are compared in Figure 3.6.1. The greatest disparity between the two methods is in Mille. This was the first center surveyed and some of the problems with the methodologies may have been sorted out in time.

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 diarrhoeal disease control. The incidence of diarrehea reported in the household survey is lowest in Bati and highest in Bichena and Chagni. This correlates weakly with the level of diarrehea disease control awareness (correlation coefficient (CC) 0.4, where 1.0 is maximum positive relationship and -0.1 is maximum negative relationship).

By totaling the sanitary indicator behaviors reported in the household survey, scores for sanitary behaviors have been calculated against the full scores of 1600 (see Figure 3.6.8). These scores have a strong negative relationship with reported incidence of diarrehea (CC -0.7) and a less strong positive relationship (CC 0.4) with diarrhoeal disease control awareness (Refer to Figures 3.6.2 and 3.6.3). This means that the better the sanitary behaviors the less risk a household will have of suffering with diarrehea, but that knowledge about diarrhoeal disease control is not the main determining factor affecting the sanitary behaviors practiced by a household.

Gender segregated data is shown for the sanitary education activities in Figures 3.6.4 to 3.6.7, showing that men and women have similar levels of knowledge about diarrhoeal disease control but slightly more women have awareness of ORS. Boys and girls (under the age of 15 years) are much less likely to be aware of this information. This reflects the access to existing health education activities and suggests gaps which need to be filled during the implementation phase. Similar monitoring at a later stage will provide data with which to compare the impact of any intervention.

There are many factors which influence sanitary behavior in addition to awareness of diarrhoeal disease control. In some households there are blocks with lack of control of resources, i.e. lack of control over land to prevent other people using a nearby site for open defecation or preventing building of latrines on that land, and lack of money for the purchase of soap for handwashing etc. Blocks to resources are usually combined also with lack of motivation and a tendency for people expect improvements to happen for them, rather than making them happen themselves. The approach for sanitary education should be tailored to meet the needs of people concerned.

Although women generally have the role of teachers and caretakers of sanitary behaviors, men and women share control over the resources which determine sanitary facilities. Sanitary education needs to be targeted at both men and women. Success of a sanitary education program will also depend on ensuring that the improved practice is easy to adopt, and will provide prestige or praise from peers and other community members.

Figure 3.6.8 shows the responses of the household survey to each sanitary behavior indicator. The exact level of compliance for sanitary behaviors to be significant in disease transmission within a community are unknown. However it has been suggested by various authors that a compliance above 75% with a sanitary behavior is significant in blocking disease transmission through that route (van Wijk and Murre, IRC 1994).

There are four behaviors above the 75% line in this Study. These are for covering water containers, covering cooked food before eating, not eating unwashed fruit and vegetables and not keeping animals in the home. These behaviors do not require any change through the sanitary education program.

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 the 25% and 50% lines are also poor. They are handwashing 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.

The remaining behaviors are access to piped water, keeping water scoop and kitchen utensils off the floor and latrine coverage and use by all family members. These are too low to block disease transmission completely but are not the priority behaviors for the sanitary education program. They could be viewed as the longer term objectives for the program when other activities have been tackled.

The priority level corresponding to the type of behavior mentioned above are summarized in Table 3.6.1 with the blocks to improve the practice. The table suggests measures and those priority for improving health and sanitation as well as the focal point.

Figure 3.6.1 Levels of Health Awareness

Groups compared to household interviews

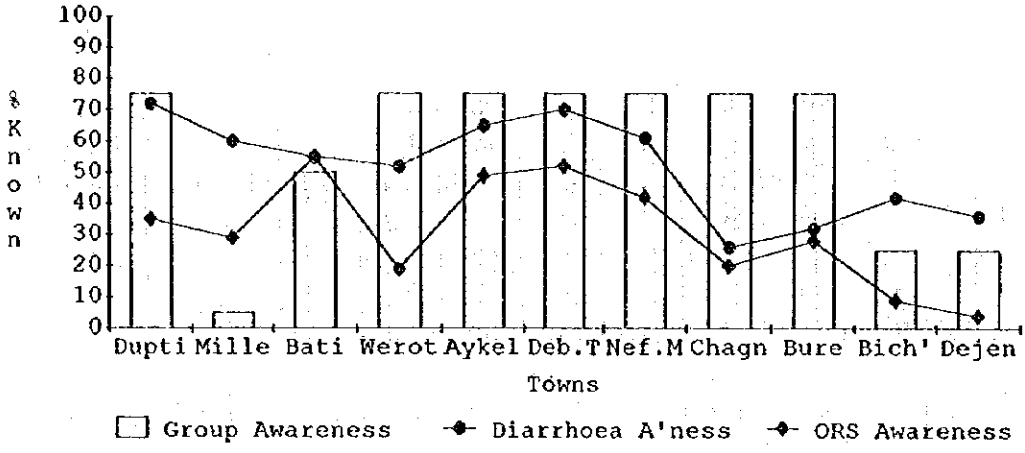


Figure 3.6.2 Diarrhoea and Indicator Behaviours

Results of household survey

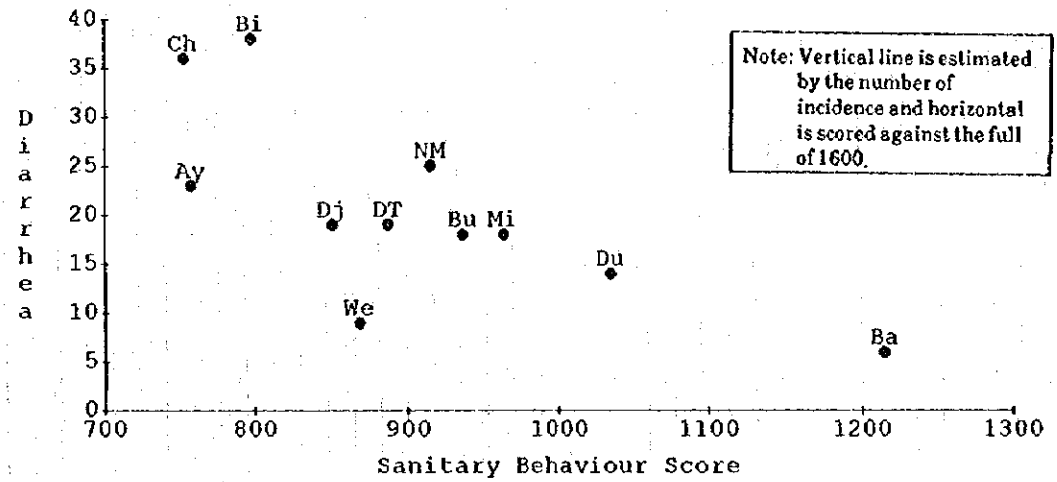


Figure 3.6.3 Awareness and Indicator Behaviours

Results of household survey

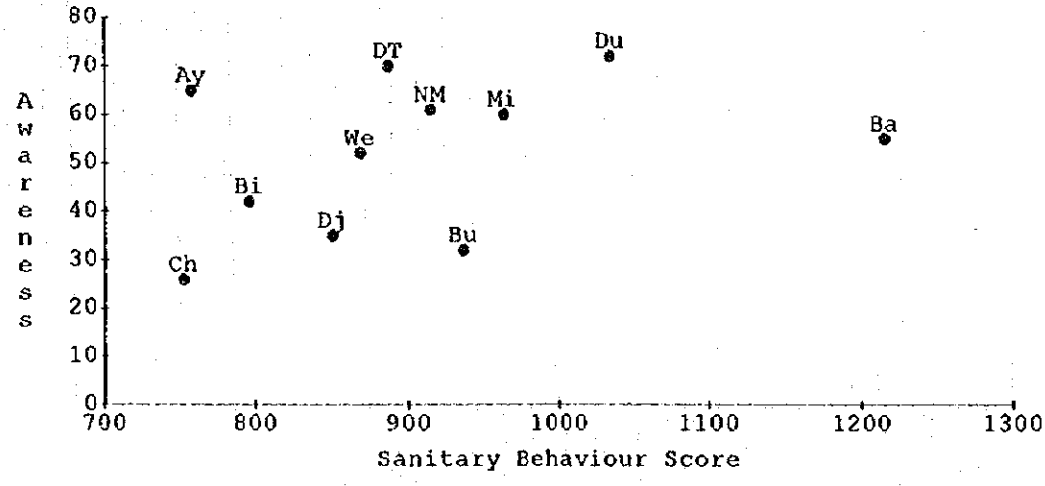


Figure 3.6.4 ORS Awareness

Differences by Gender and Age

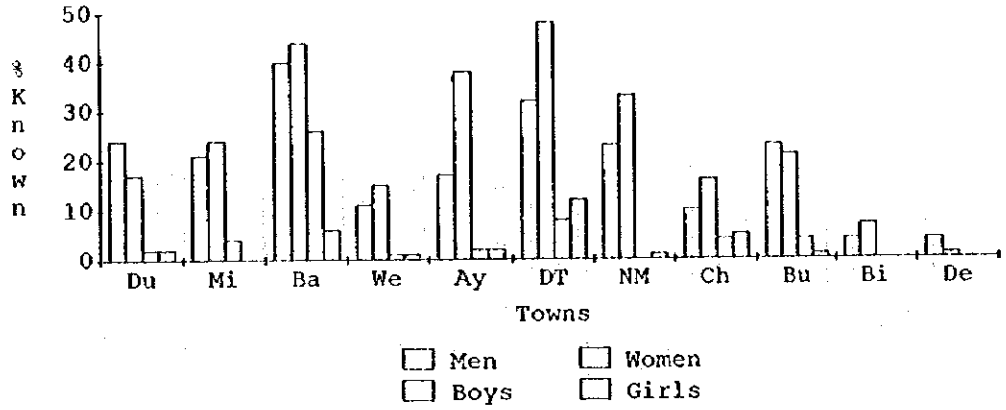


Figure 3.6.5 Diarrhoea Awareness

Differences by Gender and Age

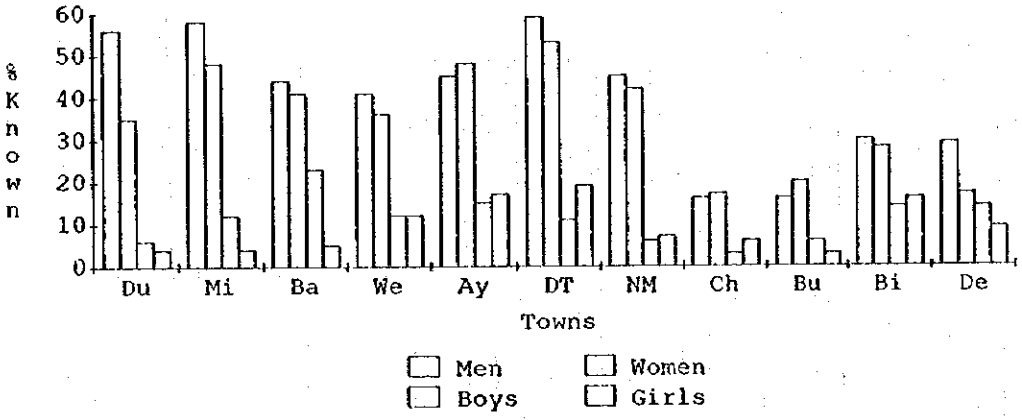


Figure 3.6.6 Health Education Sessions

Attendance by Gender and Age

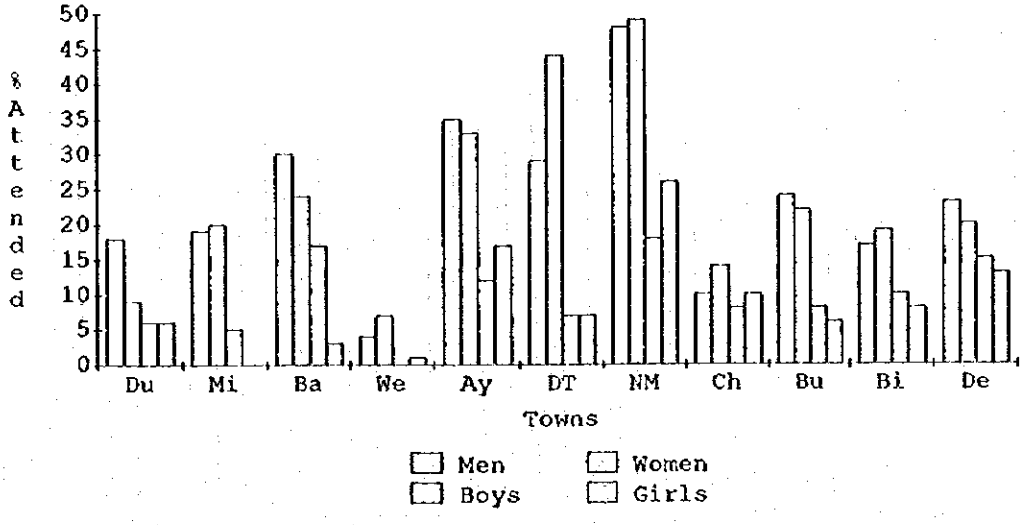


Figure 3.6.7 Health Education and Awareness

Differences by Gender and Age

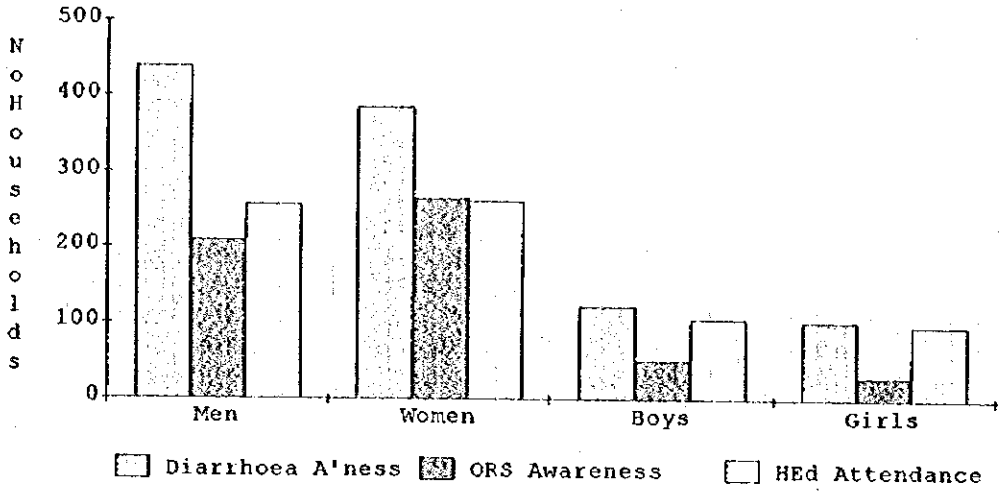
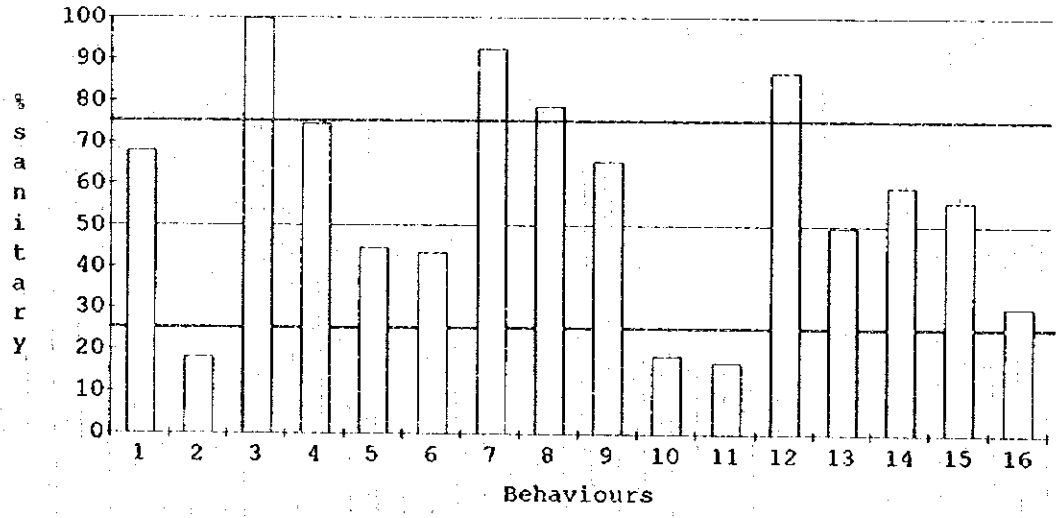


Figure 3.6.8 Indicator Sanitary Behaviours

AVERAGE FOR ALL TOWNS



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

Table 3.6.1 Priority Level, Type of Behavior and Blocks to Improved Practice

Priority Level	Type of Behavior	Blocks to Improved Practice
High	Piped water used always	Piped water not always available in sufficient quantities (WSS role) and not available when required by people (WSS role) at sites convenient for collection (WSS role)
High	Solid waste disposal in covered pits or burned	Sites not allocated for public waste disposal sites or not managed strictly (Municipality/Woreda role) Individuals must be informed of where they can dispose of waste (Municipality/Woreda role) and shown safe disposal techniques (CPP/all)
High	Waste water disposal in pits, drains or vegetable gardens	Drainage insufficient for all towns, and disposal into drains not strictly managed (Municipality/Woreda role) Individuals must be informed of where they can dispose of waste water (Municipality/Woreda role) and shown safe disposal techniques (CPP/all)
Medium-High	Handwashing after defecation	Personal hygiene (all) made more easy by making access to water and soap/ash nearer to the latrine (women's role) and by improving the status of the Improved Behavior (all)
Medium-High	Handwashing after handling children's stools	Personal hygiene (women, boys and girls roles) made more easy by improving access to water and soap/ash nearer to latrine (women's role) and improving the status of such Behavior (all's role)
Medium-High	Fly Control	Associated with climate but also related to solid and liquid waste disposal and excreta disposal (Municipality/Woreda/All role) Behaviors like covering of food and water pots during storage should be maintained (CPP/All)
Medium-Low	Access to Piped water	Improved access and level of piped water supply (WSS role) all use water but this depends mostly on opening times, location of supply sources and to a lesser extent to price (Women/girls role particularly)
Medium-Low	Water scoop and kitchen utensils kept off the floor	Domestic hygiene (women's role) although facilitated by shelf or similar available in kitchen to keep utensils on (women and men's role) Construction of such shelves to be promoted (CPP)
Medium-Low	Latrine coverage for all households	Latrine availability to be increased - Public Latrine construction and maintenance (Municipality/Woreda role) - Community/private latrine construction and maintenance (WSS/CPP/ALL role) easier with examples of low cost latrines/loans for latrines (WSS)
Medium-Low	Latrine use by all household members	Where there is a latrine, generally all household members use it. This should be encouraged and status of latrine users promoted (All)

3.7 Organization and Management

3.7.1 Present Situation

The new government was inaugurated in September, 1995 after a four-year-rule by the Transitional Government of Ethiopia. Along with it, overall governmental reorganization is being carried out.

WSSA which was directly in charge of the JICA Eleven Centers Study was formerly under MNRDEP. Now, the agency is disbanded and non-existent. The departments and services which comprized WSSA are now under MWR along with the departments and services of the former Water Resources Development Authority (WRDA). WRDA was under MNRDEP as WSSA was before. The Ministry will have 616 staff. The organizational chart of the new Ministry with the number of personnel for each department/service is shown in Figure 3.7.1.

Governmental reorganization at the regional level is going on. The related regional organizations under the new government are shown in a skeletal form in Figure 3.7.4. As it shows, there is Water, Mine and Energy Bureau (Amhara Region) or Water Resources Bureau (Afar Region) under a regional government. Under the bureau, one sees Water Supply Section, which is the organization corresponding to the former regional office of WSSA. The number of personnel in Water Supply Section in a region is not known at the present moment as the status of reorganization at the regional level is still fluid. WSS's in centers are now under the section. MWR performs planning of related national projects for Regions, Water Supply Section execution of those projects and WSS operation and maintenance of post-project facilities.

Decentralization and privatization are a major trend of the modern times in a global scale. The undercurrents are the introduction of the principle of economics, self-finance, self-reliance and pragmatism to the government organizations and state-run enterprises. The division of the functions among MWR, Water Supply Sections of regional government and WSS's follows this trend.

WSS is rated as one of five classes based on the size of population and related facilities it is in charge of. WSS may take care of water supply and sewerage/sanitation in the surrounding satellite towns, to which additional manpower is allocated. Daily water supply in a town can be managed by Water Committee in accordance with the consent of people.

Out of Eleven Centers concerned, Dupti and Mille belong to Afar Region and all the remaining centers to Amhara Region. Dupti and Mille are satellite towns of Asayta, therefore water supply and sewerage/sanitation in the two centers are organizationally under WSS of Asayta. Water Committee governs Aykel's water supply. The remaining eight centers have their own WSS, which are rated as Class 4 except Bati and Bure, both of which are Class 3 (See Table 3.7.1).

The theoretical organization set-up of WSS is shown in Figure 3.7.5. The total number of personnel of the WSS's in the Eleven Centers comes to 190, the average per WSS working out to 17.

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.

Table 3.7.1 Classification of Eleven Centers

Region	Category	Center	Class
2	Satellite	Dupti	-
		Mille	-
3	Urban	Bati	4
		Bichena	3
		Bure	4
		Chagni	3
		Debra Tabor	3
		Dejen	3
		Nefas Mewcha	3
		Werota	3
	Rural	Aykel	-

Sanitary education in the towns is done at medical institutions such as the hospital, health center and health clinic and also at schools. Institutionally, the construction and operation/maintenance of sanitation facilities such as the public toilets are to be performed by municipalities.

Evaluation of present situation is summarized below:

- Most of the WSS's concerned are in a dire financial and managerial strait essentially due to an acute shortage of water and low water tariff. Office buildings are dilapidated, staff are under-paid, they have no vehicles, they have little supply of materials on hand all because of the above reasons.

- Such authority as decision-making on water tariff and employment/dismissal of WSS's employees are under the regional office.

- Rural population is incessantly flowing into the regional urban centers seeking job opportunities, along with the age-old culture on sanitation (excretion in open field). Population concentration is aggravating the sanitary conditions of the towns, precipitating a high incidence of related diseases.

- The above situations can be considered to have been brought about by a lack of proper, far-sighted and all-inclusive sector planning on the part of government.

- 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.

- According to the results of the socio-economic surveys conducted by JICA, the majority of people are in favor of community management of water supply (Refer to Table 3.7.2).

- 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.

Table 3.7.2 Households Favoring Community Management of Water Supply (Unit : %)

Dupti	Mille	Bati	Werota	Aykel	Debre Tabor
100.0	81.0	44.2	57.4	63.5	71.4

Nefas Mewcha	Chagni	Bure	Bichena	Dejen	Average
46.1	83.0	89.8	75.8	86.7	72.6

3.7.2 Proposed Measures for Water Supply

MWR will always keep in mind to provide sufficient piped water to the people. Water requirement of the people depends on the three things, namely the per capita water demand, the size of population and service ratio. The requirement can in some cases be not easy to be met due to the supply side constraints. Anyway, it should have a long-range water supply plan for the towns and villages in the whole nation and prepare financial and human resources to implement it.

Water Supply Department of regional government will execute the water supply projects planned by the central ministry. After a project is completed, the facilities will be transferred to WSS for daily operation and maintenance. Water Supply Section will keep vigilance so that the financial, technical and manpower requirements of WSS's under its jurisdiction will be always met. In providing such assistance, the section will strictly evaluate the managerial performance of WSS's.

WSS will perform daily operation and maintenance of water supply facilities. For WSS, to be financially self-sufficient is the most important thing. Every effort will be exerted to that end. There are two major fronts to attain it, namely increase of income and curtailment of expenditures. Out of the two, the former essentially holds the key. The enhancement of income depends on two things, that is, the volume of water consumption and water tariff.

The volume of consumption essentially depends on the volume of production. Production in turn depends on the capacity of water sources. The level of water tariff is determined by the income level of the people.

When WSS makes profit continuously, it will give rise to a desirable financial climate whereby to increase income in a spiral way.

Management of WSS will be left to WSS itself. That is, decision-making on water tariff shall be in its hand. It will employ or dismiss employees based on its own judgment. It will develop small scale water sources using its own fund. These things will be, however, subject to the approval of Water Supply Section of regional government.

To meet the requirements for more skilled manpower in parallel with the enhanced activities and role of WSS, a training center will be established under Water Supply Section in a region. A workshop will also be incorporated in it.

If there is an overwhelming support of the people, the entire functions of WSS will be transferred to Water Committee.

3.7.3 Proposed Measures for Sewerage/Sanitation

MWR is institutionally in charge of not only water supply but also sewerage/sanitation. However, in reality it has not done anything in connection with sewerage/sanitation, so far as Eleven Centers are concerned.

Clean water is essential for human life. In this sense water supply is a high priority requirement. Compared with it, one can live without any sanitation facilities. Besides, there are cultural, climatic, financial and other factors that are detrimental to the introduction of modern sanitary measures.

However, the ever-increasing concentration of population to the centers has made sanitary situation and environment around them acute and grave, exemplified by a high incidence of related diseases.

It is now high time for the authorities to think seriously of improvement and alleviation of sanitary conditions in Eleven Centers. To attain the objective, there will be two major fronts, namely the promotion of sanitary awareness and the promotion of construction of sanitation facilities.

Sanitary awareness of people will be promoted as has been the case through the health center and schools. Sanitary education will be facilitated by using sanitation manuals. Also, group meetings and discussions in the community will be held to inplant the awareness. It is proposed that Sanitary/Health Committee be established to coordinate such activities.

Sanitation facilities mean toilet such as septic tank toilet and dry pit latrine, emptying equipment and treatment/disposing pit. According to the socio-economic questionnaire surveys conducted by the Team, the majority of the people of Eleven Centers want to have

one of the above two types of toilet. Also, a substantial part of them are willing to construct septic tank toilets if the authorities provide them with the subsidy/loan.

Prompted by such assuring thinking and requirement of the people, the Team proposes to incorporate necessary functions related to sewerage/sanitation in the MWR organizational set-up. It is the requirement of the times for MWR to shoulder the active role for sewerage/sanitation.

The construction of individual sanitation facilities, that is, household toilets will be promoted by MWR. On the other hand, the construction of public toilets will be done by the municipality basically financed out of its own coffer as supposed to be the case.

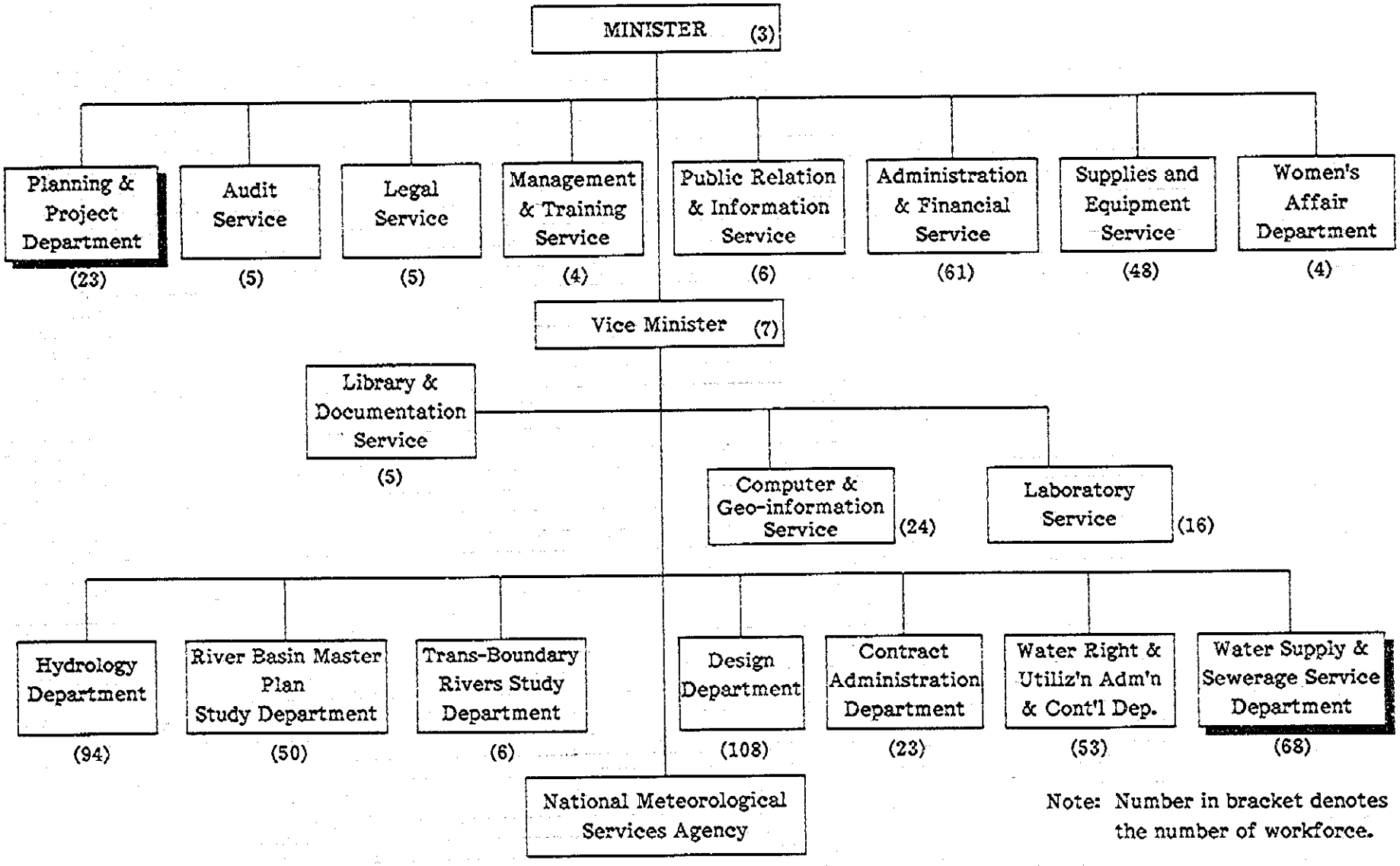


Figure 3.7.1 Organizational Chart of Ministry of Water Resources

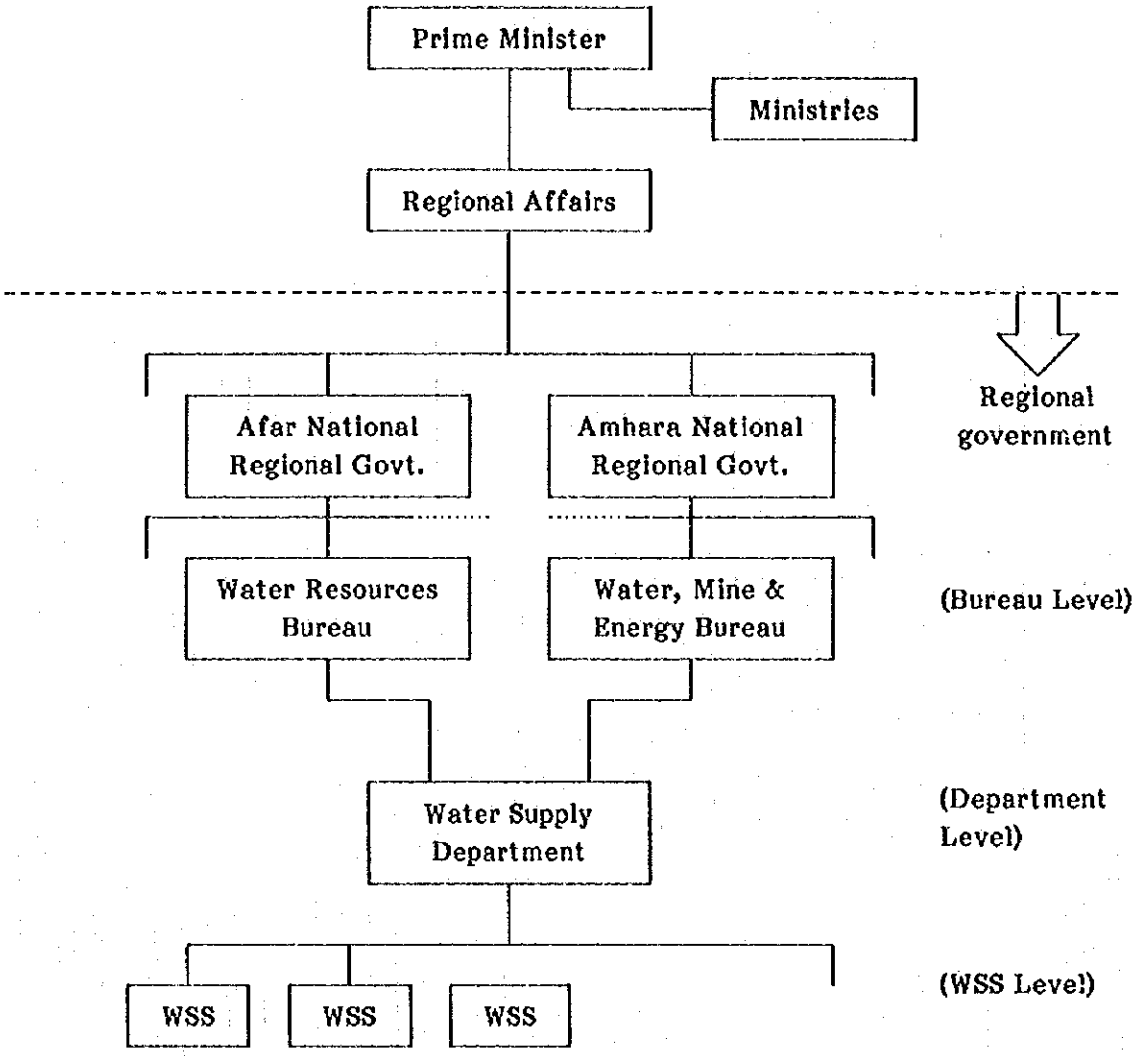


Figure 3.7.2 Related Organizations at Regional Level

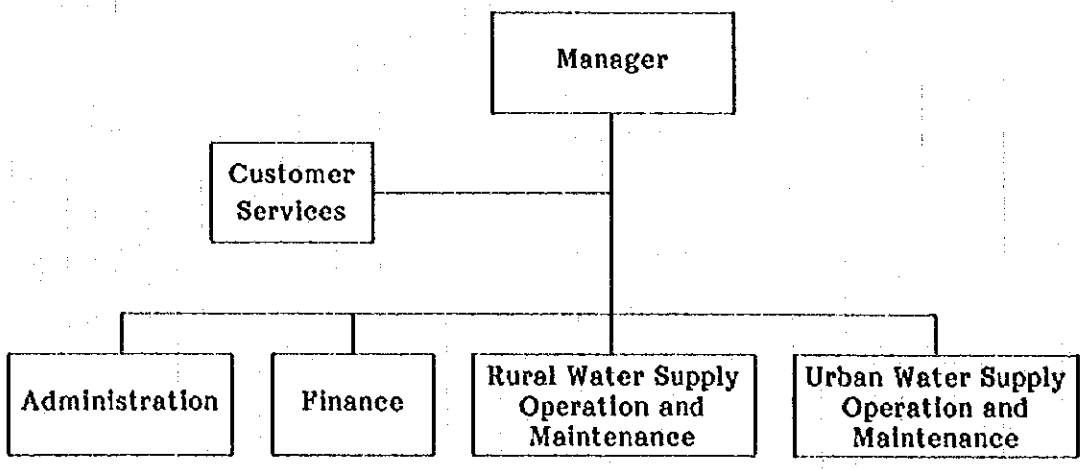


Figure 3.7.3 Typical Organizational Set-up of WSS

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 limited production of water means a limited number of clients and, hence, a limited consumption of water. Water price stays the same for years in spite of a sharp price rise of fuel which is a major component of cost. Low water price means a limited income per unit consumption of water. Income delivers from the consumption of water multiplied by income per unit consumption of water. As both of them are limited, there is no other way but to have a limited income.

To resolve the second problem, two institutional measures are introduced; namely, progressive water tariff and double entry accounting system.

3.8.1 Introduction of Progressive Water Tariff

The concept of progressive water tariff is:

- Water is one of basic human needs. In this sense every household, poor and rich, has a right to have access to it,
- Water payment should be within several percent of household income,
- The richer you come, the more you consume water, and
- Income from water charges must cover the O & M cost as well as a part of capital cost.

If WSS is to be financially sustainable, two prerequisites must be satisfied: one is an ample supply of water and another is a reasonable level of water charge. Under the present circumstances the first condition is clearly not satisfied. It is suspected that the second one is also not met. In the target years water requirement will be fulfilled. Therefore, it is essential to work out a proper water tariff to make WSS financially self-sufficient.

Naturally, the home economy cannot stand over-expensive water price. World Bank recommends that water payment be within several percent of household income. Also, water is one of basic human needs. In this sense, every household has a right to have access to it.

On the other hand, WSS must make both ends meet as a financially independent entity. The water price will be established in such a way that income may cover the operation and maintenance cost as well as a part (up to something like 50%) of intitial cost.

Taking the above things into consideration, the introduction of the progressive water tariff system is proposed. The concept behind it 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.

This system can raise the average water price without affecting low-income households. Also, the rich subsidize the poor under the system. This is one form of cross-subsidy.

3.8.2 Introduction of Double Entry Accounting System

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.

The existing system contributes to pushing WSS to financial difficulties. what it has as profit is often actually capital cost. Probably it has no fund to rehabilitate, replace or newly construct facilities.

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.