

GOVERNMENT OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
STATE OF ERITREA
MINISTRY OF LAND, WATER AND ENVIRONMENT

STUDY
ON
GROUNDWATER DEVELOPMENT AND WATER SUPPLY
FOR
SEVEN TOWNS IN SOUTHERN REGION
OF
ERITREA

FINAL REPORT

DEBARWA

VOLUME II APPENDIX

JANUARY 1999

DAIICHI CONSULTANTS INC.

JICA LIBRARY



J 1147593 [6]

S S S

J R

99-006

GOVERNMENT OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

STATE OF ERITREA
MINISTRY OF LAND, WATER AND ENVIRONMENT

STUDY
ON
GROUNDWATER DEVELOPMENT AND WATER SUPPLY
FOR
SEVEN TOWNS IN SOUTHERN REGION
OF
ERITREA

FINAL REPORT

DEBARWA

VOLUME II APPENDIX

JANUARY 1999

SANYU CONSULTANTS INC.



1147593 [6]

List of Reports

This volume is part of the following reports:

Executive Summary

Debarwa	Volume I	Main Report
	Volume II	Appendix
	Volume III	Drawings
Mendefera	Volume I	Main Report
	Volume II	Appendix
	Volume III	Drawings
Adiquala	Volume I	Main Report
	Volume II	Appendix
	Volume III	Drawings
Dekemhare	Volume I	Main Report
	Volume II	Appendix
	Volume III	Drawings
Segeneiti	Volume I	Main Report
	Volume II	Appendix
	Volume III	Drawings
Adi Keyih	Volume I	Main Report
	Volume II	Appendix
	Volume III	Drawings
Senafe	Volume I	Main Report
	Volume II	Appendix
	Volume III	Drawings

Operation and Maintenance Manual for Water Supply Facility

Hygiene Education Manual

Training Manual for Staff of WSA

LIST OF APPENDICES

- A. SOCIO-ECONOMY
- B. METEOROLOGY AND HYDROLOGY
- C. HYDROGEOLOGY
- D. WATER SUPPLY
- E. SANITATION
- F. COST ESTIMATION
- G. FINANCIAL PLAN
- H. ENVIRONMENT

APPENDIX A
SOCIO-ECONOMY

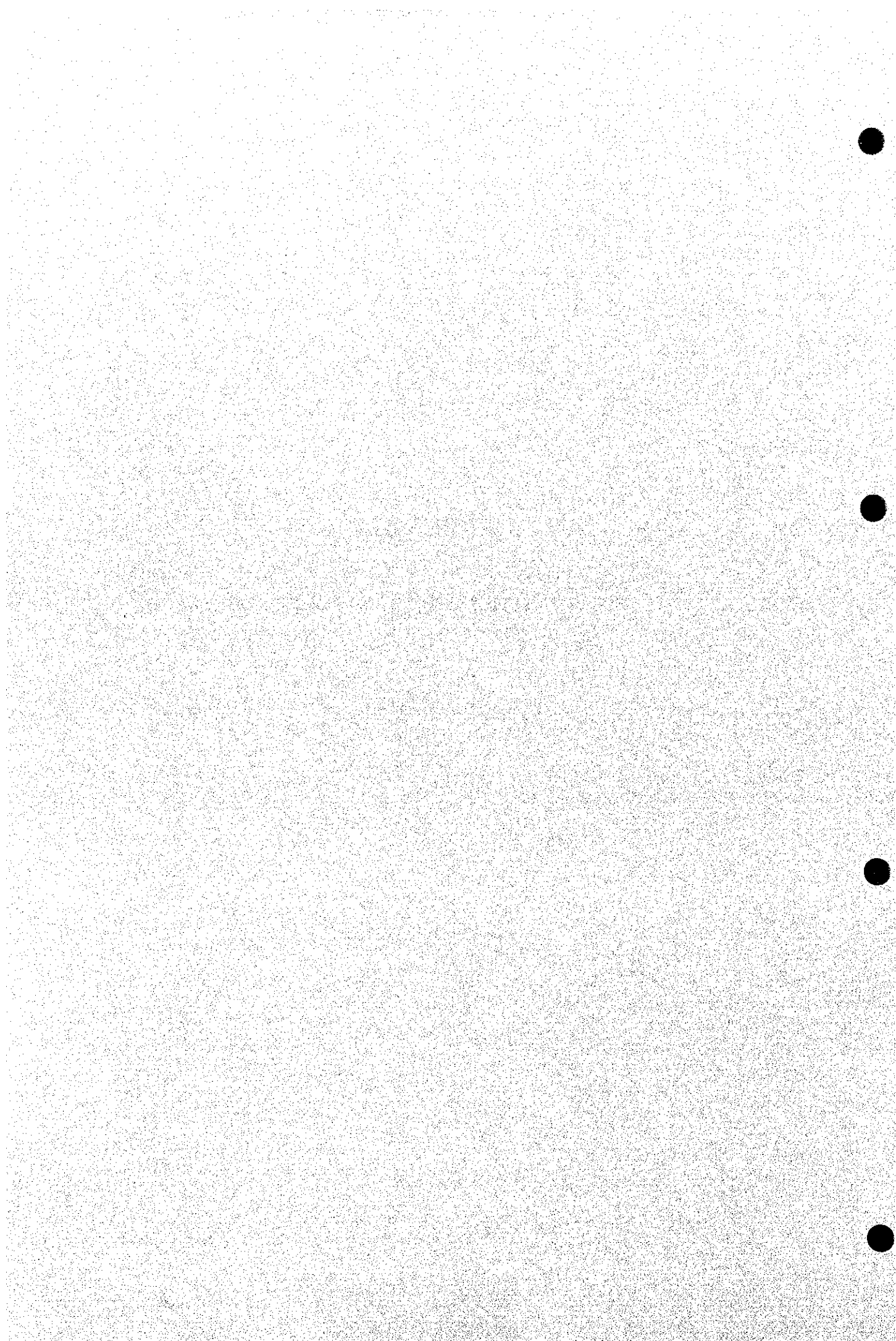


TABLE OF CONTENTS

	Page
CHAPTER 1 HOW TO USE THE APPENDICES ON SOCIO-ECONOMIC CONDITIONS.....	A-1
CHAPTER 2 ASPECTS OF DECENTRALIZED ADMINISTRATION IN ERITREA	A-2
2.1 Introduction	A-2
2.2 Functions of Zoba Administrations.....	A-2
2.3 Aspects of Discretion.....	A-3
2.4 Aspects of Access	A-5
CHAPTER 3 THE DEBUB REGION.....	A-6
CHAPTER 4 CURRENT SITUATION IN DEBAREWA.....	A-15
CHAPTER 5 STRATEGY ON PLANNING.....	A-22
CHAPTER 6 DEVELOPMENT PROGRAMME	A-23

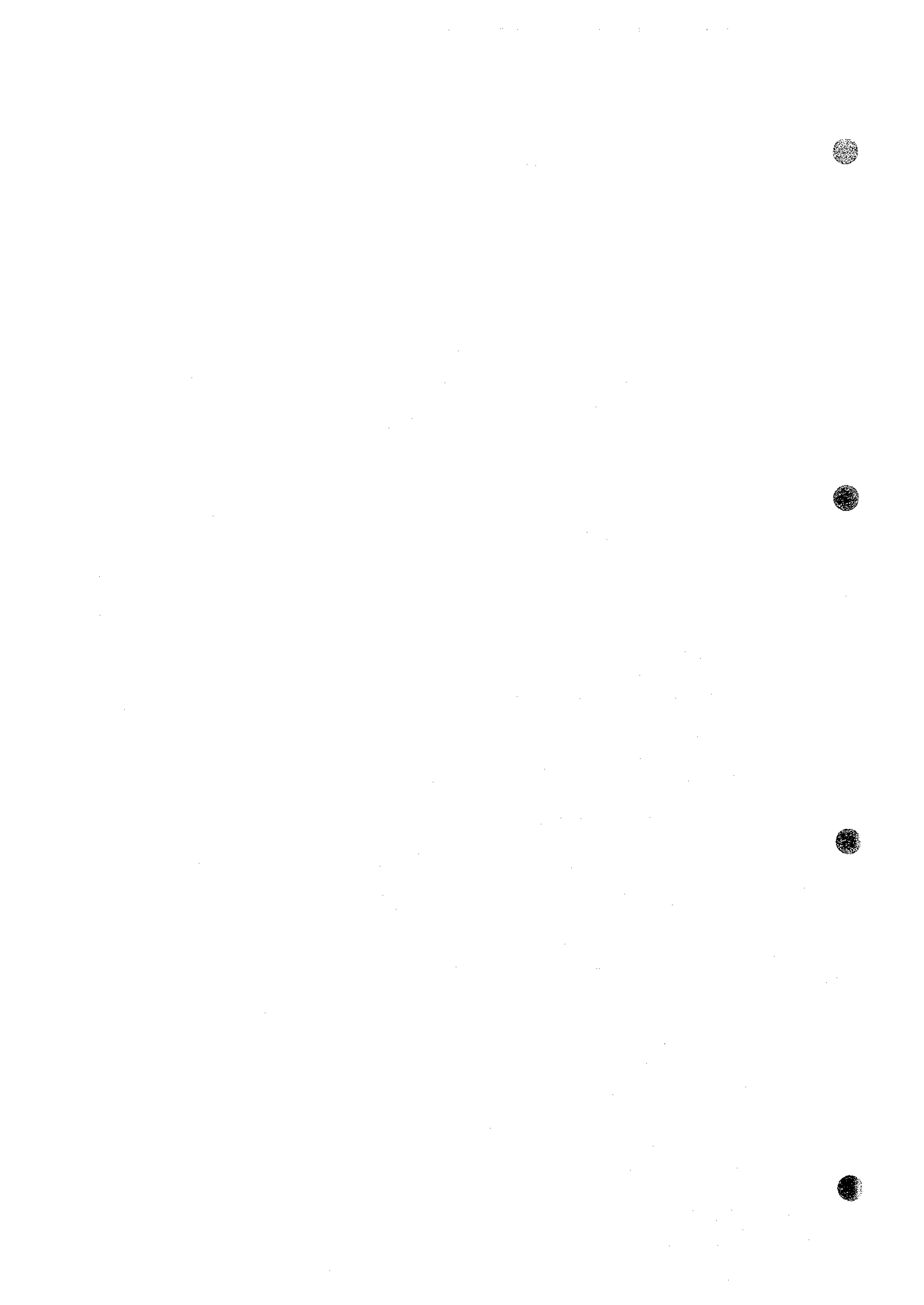
LIST OF TABLES

Table 3.1	Number of Neus Zoba, Village Administrations and Villages in Debub Region.....	A-9
Table 3.2	Population and Household Size of Debub Region.....	A-9
Table 3.3	Composition of Ethnic and Religious Groups in Debub Region	A-10
Table 3.4	Percentage Distribution of Ethnic Groups in Debub Region.....	A-10
Table 3.5	Manpower Status of Debub Zoba Administration and the Towns.....	A-11
Table 3.6	Administrative Status of the Seven Towns.....	A-11
Table 3.7	Enrolment in Debub Region.....	A-11
Table 3.8	Health Personnel In Debub Region.....	A-12
Table 3.9	Number of Seats and Occupancy Rates of Hotels and Restaurants	A-12
Table 3.10	Number of Workers in Non-Household Institutions.....	A-12
Table 3.11	Percent of Power Failure, Average Capacity of Own Generator by Type of Establishment (for all towns)	A-13
Table 3.12	Women Organizations by Type of Establishments	A-13
Table 3.13	Average Daily Water Consumption by Type of Establishments (in M3).....	A-13
Table 3.14	Percentage of Households Average Daily Water Consumption in Dry and Rainy Seasons	A-14
Table 4.1	Percentage Distribution of HH Heads by Sex, Size, Religion and Ethnic	A-15
Table 4.2	Occupations of HHs.....	A-15
Table 4.3	Crop Production (Qts) and Consumption (Percentage).....	A-16
Table 4.4	Livestock and Agricultural Land Status of HHs.....	A-16
Table 4.5	Average HH Income by Occupation, Ethnic Group and Religion (Nfa).....	A-16
Table 4.6	Percentage of HHs by Income Groups and Average HH Expenditure by Item	A-17
Table 4.7	Educational Status of HHs	A-17
Table 4.8	Percentage of HHs by Daily Activity of Women and Girls.....	A-17

Table 4.9	Percentage of Participation of Adult Women on Educational Sessions of Social Activities	A-18
Table 4.10	Percentage of HH Members Participating in Community Organizations	A-18
Table 4.11	Percentage of Participation of Adult Women in Communal Activities.....	A-18
Table 4.12	Percentage of HHs by Major HH Problems	A-19
Table 4.13	Percentage of HHs by Problems Related to Existing Water Supply Facilities.....	A-19
Table 4.14	HH Average Daily Per Capita Water Consumption of Water for all Seasons From All Sources by Income Group	A-19
Table 4.15	Percentage of HHs Affording to Pay for Water by Income Group	A-20
Table 4.16	Percentage of HHs Affording to Pay for Community Toilets by Income Group	A-20
Table 4.17	Communal Water Points.....	A-21
Table 5.1	Population Projection for the Town of Debarwa	A-22

LIST OF CHARTS

Chart 3.1.	Organizational Chart of Zoba.....	A-6
Chart 3.2.	Organizational Chart of Nues Zoba	A-7
Chart 3.3.	Organizational Chart of Town Administration	A-8
Chart 6.1.	Organizational Structure of the Ministry of land, Water and Environment.....	A-23
Chart 6.2.	Organizational Structure of Regional Affairs Department, MoLG.....	A-24
Chart 6.3.	Organizational Structure of the Ministry of Health	A-25



CHAPTER 1 HOW TO USE THE APPENDICES ON SOCIO-ECONOMIC CONDITIONS

The final report on the study of Water Supply and Sanitation Project of the seven towns in Debub Region has four major components: the descriptions of the Natural Conditions in the Debub Region (including topographical, geological, hydro-geological and meteorological conditions), hygiene and sanitation, and finally financial and socio-economic conditions.

Following the contents developed for the final report, the socio-economic aspects of the study are dealt in all chapters. In particular, Chapter 2 exclusively deals with the economic and social aspects of Eritrea, and the regions economic and social conditions are also dealt in detail in Chapter 3. In Chapters 6 and 7, the social and economic aspects of the programme and project development are dealt even in greater detail.

In order to enable us to concentrate on the most substantive aspects of the report, we have opted to make wide use of the appendices for the socio-economic part of the report. For example, all tables and data secured from the study survey or from region and/or sectoral ministries, have been included in the appendices and only the analysis of these data and information have been highlighted in the main report. In like manner, all organizational charts pertaining to relevant ministries and the Debub Region have been included in the appendices.

All appendices of the final report are to be found in Volume II. As there are separate reports for each town, there are also separate appendices for each town. For example, Volume II-I is assigned for Debarewa, and Volume II-II is for Mendefera, etc. In Appendices Volume II-I of Debarewa, for example, all appendices related to socio-economic conditions can be referred to in part A which, has its own contents and arrangements. In the common chapters and main reports of individual towns, reference to a table from Chapter 3 is written as table---(Table no.) appendix A, and reference to a table in Chapter 4 is written as Table---(table no.) appendix A, etc.

CHAPTER 2 ASPECTS OF DECENTRALIZED ADMINISTRATION IN ERITREA

2.1 Introduction

Following the liberation of the Eritrea in May 1991, one of the tasks of the Government was to begin rehabilitation and reconstruction of the socioeconomic infrastructures of the country. Indeed, water was and still remains one of the top priorities in this continuous task. In seeking the active participation communities in this endeavour, the rich experience of community participation attained during armed struggle became an added advantage. Community participation was raised to a higher level by strengthening village/kebab and town assemblies or "Baitos" in all structures of the regional administration. Additionally, the publication of the macro-policy of the government towards the end of 1994 (which defined the long term vision of what the Eritrean economy, and indeed, its people would be like after 20 years), was clearly and unambiguously articulated. Thus, the need not to only systematise the planning tools – approval, review and up-dating mechanisms and procedures – became apparent; but along with this effort also arose the need to decentralize the regional administrations by establishing an efficient, accountable and lean civil service.

Concomitantly, the Government promulgated the Constitution of the country in early 1997 which *provides that Eritrea is a unitary state*. In its two years for its making, the wide and active participation of the people was ensured, both inside and outside the country.

As part of this process, decentralisation of public institutions via Proclamation No. 86/96, was enacted earlier in 1996. This Proclamation provided for the establishment of Regional Administrations. It defines the functional aspects of decentralization, focusing on **responsibilities** or **authority** of regional administrators. The Proclamation, *inter alia*, empowers the "Zoba Baitos" (Regional Assemblies) to prepare and implement their own regional plans and programmes with the active participation and collaboration of communities themselves. Indeed, in the preamble of the Proclamation, it is stated:

"... from its inception, the leadership of the struggle for the rights of the people have advocated that in order for the people to enjoy the resources of the country more equally, their participation in the political, social and economic areas should be enhanced"[own translation].

Before we deal with the organizational structures of the Zoba and Neus-Zoba Administrations, we shall devote some few pages on aspects of decentralisation in Eritrea as per the spirit of Proclamation No.86/96 in order to set the right context for Organizational and management issues and water and sanitation related issues in particular latter in this section.

2.2 Functions of Zoba Administrations

On the whole, the Proclamation encompasses aspects of deconcentration, devolution, top-down principal agency, bottom-up principal agency and delegation/semi-autonomous agency models of decentralisation reflecting the country's unique cultural, historical, economic and sociopolitical circumstances.

The Zoba "Baito" and the Adi/Kejabi level "Megabia" are community representatives, who are democratically elected legislative bodies at two of the three sub national levels established in terms of the

Proclamation. The Zoba Baito will have a degree of discretionary power, including the authority to enact revenue-raising measures and to approve the budget for the use of such funds. These powers represent a transfer from the national government and thus, devolution. More importantly, to complement this revenue raising power, the Zoba Baito has the duty of ensuring that all taxes and revenues are collected from the Zoba, including those accruing to the national level. This brings to the fore the democratic goal of accountability of the elected to the electorate. Only when the electorate see that their taxes and fees being paid in will they be in a position to hold the elected accountable and, in turn, demand a higher level of services. The downward linkage is directed in that the Zoba Baito has the power to approve the expenditure of "locally" generated revenues. The upward linkage is indirect in that the Zoba Baito has the duty to ensure the collection of national revenues, but it can bring direct demands on the national Baito, the supreme legislative body, if it has, in turn successfully discharged its duty to ensure the collection of all national revenue. This appears to be an exclusive duty of the Zoba Baito and is vital in participatory democratic terms.

The Zoba Baitos, can pass resolutions requesting the regional executive to direct the expenditure of certain non-national "locally" generated revenues. To accomplish this implementing function the Region executive could to indulge in the bottom-up principal agent type of decentralisation. That is, it can approve that contracts with a national level agency, such as the Ministry of Construction, to construct a social service facility, such as a health station on its behalf. Acting as its principal agent, (though the Baito could also contract directly with a private sector contractor on a turn-key basis).

2.3 Aspects of Discretion

The following are the exclusive functions of the Central Government as set out in Article 35 of the Proclamation:

- defense and internal security
- foreign affairs
- preparation national economic polices and plans
- citizenship, passport, asylum, refugees, extradition, and the like
- administration of justice and general audit; banking and related services
- administration and follow-up of economic and social infrastructures and services that cross two or more boundaries of regions, viz., central referal hospitals and higher education and training establishments
- transport and communication infrastructures(land, sea, air), viz., airports, ports
- determination of public holidays, working hours, and related national matters.

Article 36 defines responsibilities and duties of central government institutions which include:

- prepare and implement sectoral policies , plans(including capital and recurrent budgets), sector regulations, instruments and parameters

- undertake research and studies, collect and analyse statistical data and information related to the sector
- render to regional administrations technical and advisory services
- based on national rules and regulations, and considering the capacity of regional administrations, deploy human and material resources as well as recruit, train, promote/demote and fire workers
- effect chief administrators' requests for the transfer of workers, following the agreement of the MOLG and concerned ministry
- conduct training and render technical assistance in specialised areas
- seek external assistance for programmes and projects

The delineation of the main domains of regional administrations is articulated in Article 37:

- perform general administration, and implement social and economic projects and activities
- prepare regional development plans and budget, and implement when approved
- ensure that central government's policies, guidelines and procedures are followed-up and adhered to in every stage of programme/project preparation, implementation and monitoring
- collect and aggregate statistical data and information
- without prejudice to article.35 and art. 36, recruit workers when approved by the MOLG, strengthen regional administration's manpower capacity
- prepare monthly progress reports concerning programme and project implementation, and half year monitoring report to MOLG
- perform any other tasks provided for in the Proclamation

Considering the fact that decentralisation is a process to be implemented over time, it is too early to discern any absolute degree of discretion, given that the Proclamation was enacted very recently. However, objective assessment of the track record since the country's legal independence in 1993, one has reason to confidently anticipate a high level of discretion. Indeed, there is a compelling, good faith and commitment on the part of the national government to ensure that the new decentralised decision making system works, at least based on the achievements to-date.

The act of physically deploying national civil service staff to posting outside the national capital is clearly deconcentration. In the spirit of Proclamation No. 86/96, once the national civil servants are so posted, their lines of operational responsibility then take on aspects of both deconcentration and **top down principal agency**. While the Office of the Zoba Administrator is deconcentrated from the MOLG and as such functions as a "branch office" virtually all of the civil service staff in the three major departments of the Zoba Administration as a whole are themselves deconcentrated from their sector/function ministries, but are responsible in line, operational terms to the authority of the Zoba Administrator.

Nonetheless, they must also look to their sector ministry for cadre specific professional guidance and supervision and career development generally.

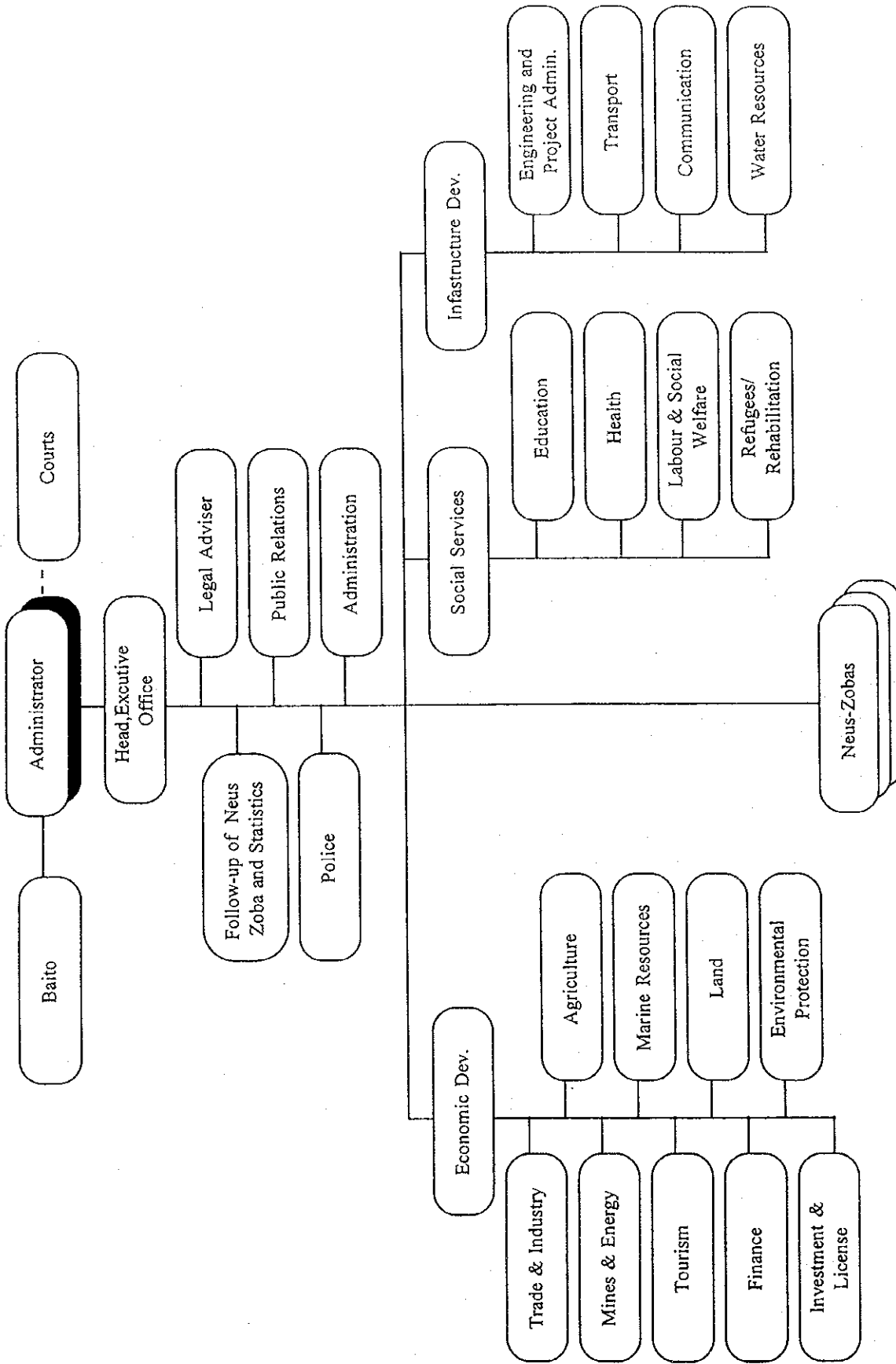
2.4 Aspects of Access

One prime objective of the decentralisation policy is to deconcentrate many national civil service staff to the Zoba level and below, leaving a lean core of policy level professional staff of ministries at the national level. This process has already begun in earnest. Moreover and the administrative and political leverage the Zoba Administrator is vested upon is an added advantage. This, indeed, is a high degree of access. The degree and level of this privilege will not be lost on any official between the Adi/Kcbabi and National level. Given the level of manpower granted to the Zoba Administrator and the apparent discretion he has in utilising this power, very little challenge this authority could face little challenge.

A critical access issue, at least in the short to the medium term, is the ability of the Zoba planners and managers to obtain financial and other information from the national level in a timely and regular manner. Valid planning requires a steady and timely flow of information on resource availability, including financial, human and physical resources. Limitation of access to such information lowers both the "certainty" level and confidence level. There is a need, at the earliest possible point in the annual planning process to furnish the Zoba Administration with at least indicative or "best guess" ceiling of capital/development expenditure, preferably on a sector by sector basis to enable a better match between likely availability of resources and expectations. Initiating such a flow of information may not be possible immediately, but institutionalising such a flow of information should be a monitored goal. The same argument and reason is valid for recurrent funds and for the supply of new, additional resources. Valid planning in a resource scarce environment involves hard choices and prioritisation. But the absence of access, or limited and delayed access to such information as noted above can have a very major impact on the effectiveness of functions and discretion, the other major dimension of the decetralisation process.

On the whole, the Proclamation encompasses aspects of deconcentration, devolution, top-down principal agency, bottom-up principal agency and delegation/semi-autonomous agency models of decentralisation reflecting the country's unique cultural, historical, economic and socio-political circumstances.

Chart 3.1: Organizational Chart of Zoba



Organizational Chart of Neus Zoba

Chart 3.2:

1. Mendefera
2. Adi keyih

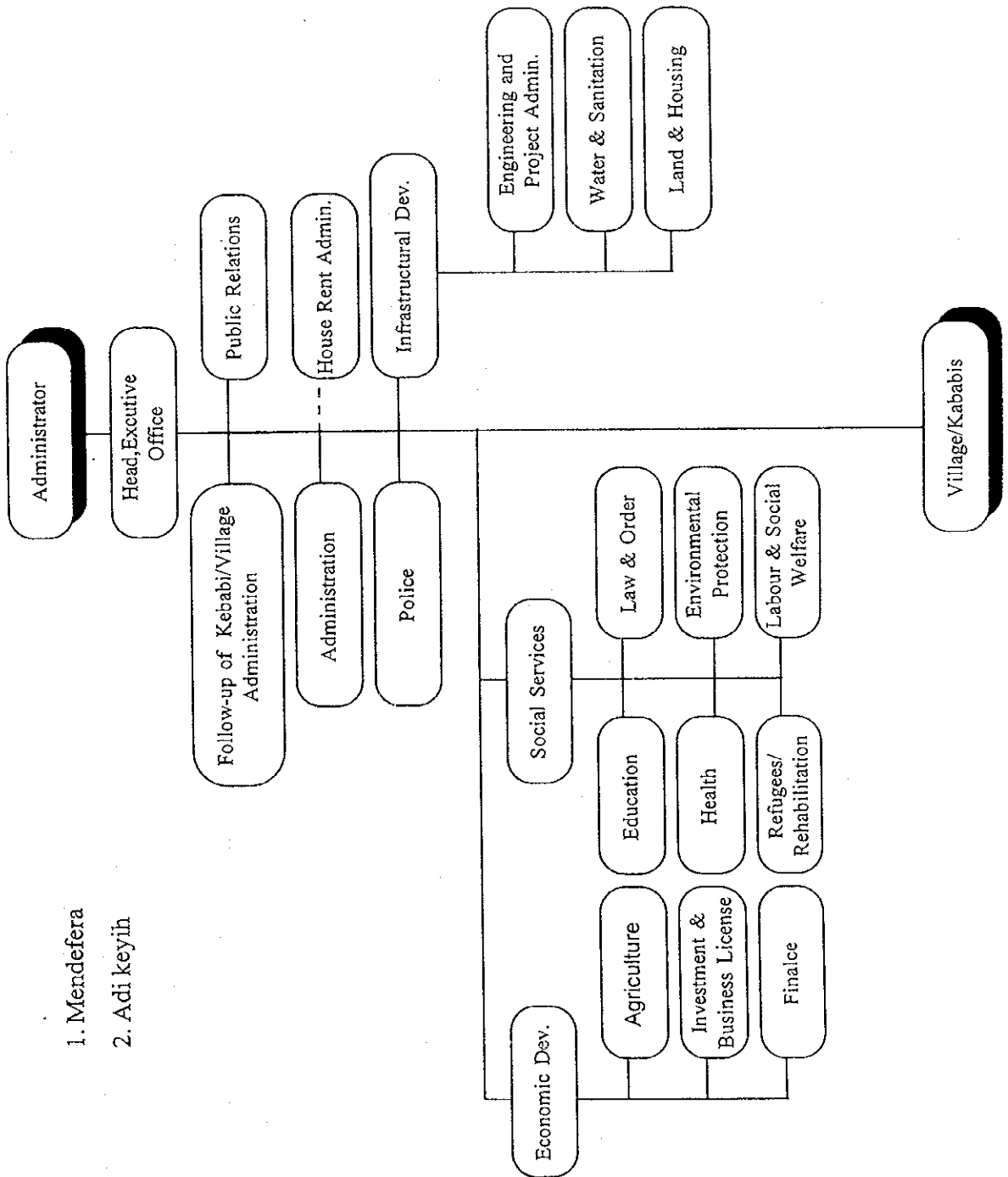


Chart 3.3: Organizational Chart of Town Administration

Chart 3.3:

1. Debarwa
2. Adiquala
3. Dekemhare
4. Segeneiti
5. Senafe

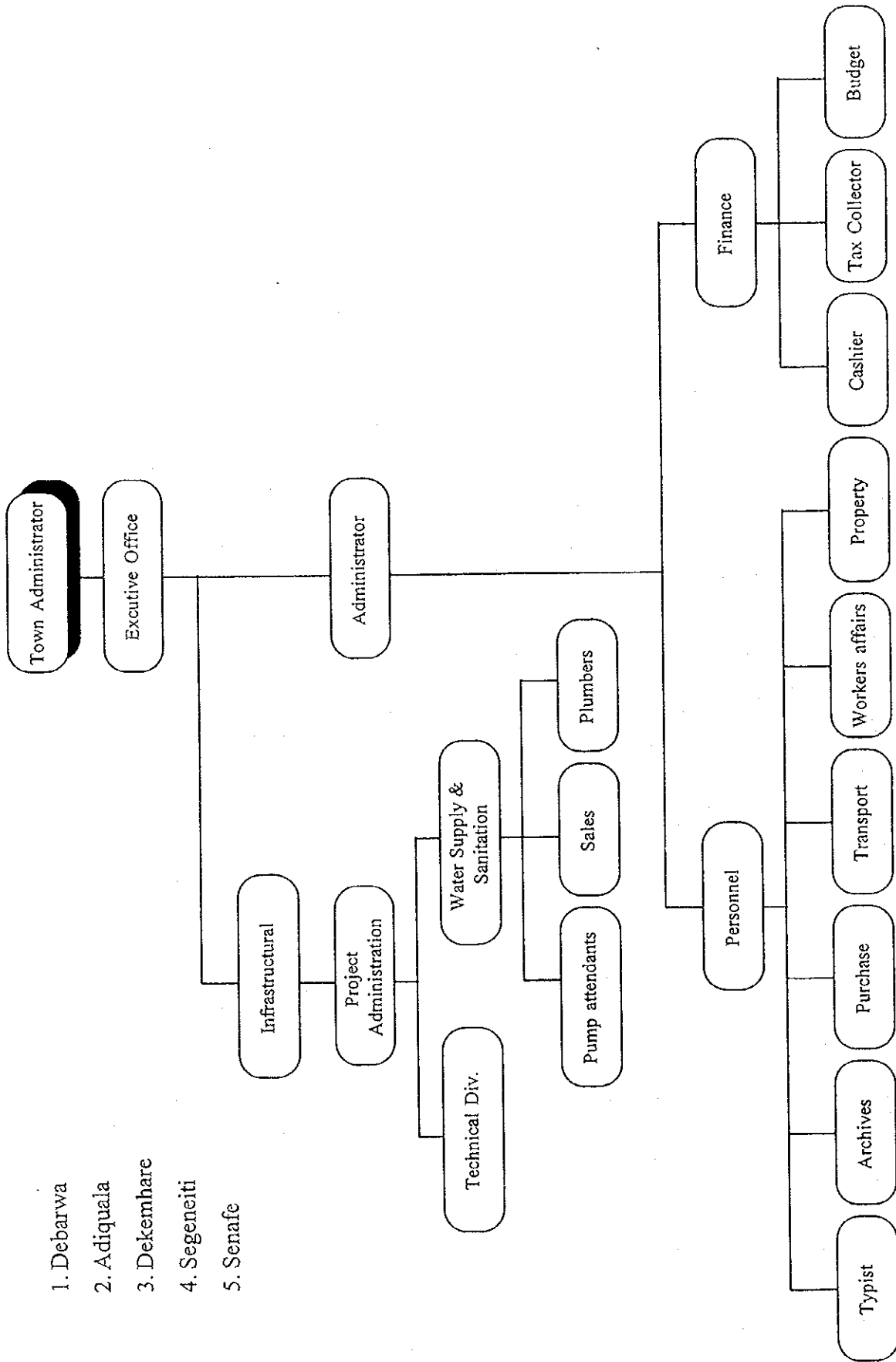


Table 3.1: Number of Neus Zobas, Village Administrations and Villages in Debub Region

Sub-Region	Main Town of Neus-Zoba	Number of Village Admin.	No. of Villages
Tsorena	Tsorena	21	116
Dekemhare	Dekemhare	19	67
Segeneiti	Segenciti	16	44
Adi Keyih	Adi Keyih	21	54
Senafe	Senafe	22	90
Mai Aini	Mai Aini	NK	NK
Mai Mine	Mai Mine	19	80
Adiquala	Adiquala	21	113
Debarwa	Debarwa	25	69
Mendefera	Mendefera	15	89
Kudobur	Kudobur	13	78
Areza	Areza	20	84
Total	11	212	884

Source: Ministry of Local Government, Town
Town Administration Departments, 1997

Note : NK stands for not known

Table 3.2: Population and Household Size of Debub Region

Neus-Zoba	Area of Neus Zoba in km ²	No. of Households	Total Population	Density/km ²	Average HH Size
Tsorena	116	12736	41886	361.09	3.3
Dekemhare	850	19187	65510	77.07	3.4
Segeneiti	380	12612	44628	117.44	3.5
Adi Keyih	1239	15957	58377	47.12	3.7
Senafe	597	26027	88718	148.61	3.4
Mai Mine	865	14272	59266	68.52	4.2
Adiquala	858	22840	90990	106.05	4.0
Debarwa	660	22325	71578	108.45	3.2
Mendefera	867	18462	66077	76.21	3.6
Kudobur	1039	11989	44282	42.62	3.7
Areza	878	16615	71190	81.08	4.3
Total	8349	193022	702502	84.14	3.6

Source: Ministry of Local Government, Town Administration Department, 1997

Table 3.3: Composition of Ethnic and Religious Groups in Debub Region

Neus-Zoba	Tigrigna	Saho	Tigre	Total Population
Tsorena	26320	6797	1128	41886
Dekemhare	41234	3198	3233	65510
Segeneiti	29116	654	1	44628
Adi Keyih	29725	13917	5	58377
Senafe	42889	11231	1	88718
Mai Mine	45363	656	801	59266
Adiquala	53649	915	43	90990
Debarwa	42239	175	0	71578
Mendefera	40581	1188	619	66077
Kudobur	38231	1302	259	44282
Areza	50551	264	851	71190
Total	439898	40297	6941	702502

Source: Debub Zoba Administration, Social Department 1997

Table 3.4: Percentage Distribution of Ethnic Groups in Debub Zoba

Neus-Zoba	Tigrigna	Saho	Tigre
Tsorena	62.84	16.23	2.69
Dekemhare	62.94	4.88	4.94
Segeneiti	65.24	1.47	0.00
Adi Keyih	50.92	23.84	0.01
Senafe	48.34	12.66	0.00
Mai Mine	76.54	1.11	1.35
Adiquala	58.96	1.01	0.05
Debarwa	59.01	0.24	0.00
Mendefera	61.41	1.80	1.0
Kudobur	86.34	2.94	0.58
Areza	71.01	0.37	1.20
Total	62.62	5.74	0.99

Source: Debub Zoba Administration, Social Department 1997

Table 3.5: Manpower Status of Debub Zoba Administration and the Towns

Level	Total Positions in the organizational structure	Filled	Unfilled
Debarwa	21	13	8
Mendefera	22	12	10
Adiquala	21	13	8
Dekemhare	21	17	4
Segeneiti	21	13	8
Adi Keyih	22	12	10
Senafe	21	13	8
Debub Zone	29	24	3

Source: Debub Zoba Administration and Respective Town Administrations

Table 3.6: Administrative Status of the Seven Town

Town	Administrative Status
1. Dekemhare	Town Administration
2. Segeneiti	Town Administration
3. Adi Keyih	Sub-zone Main Town - "Baito"
4. Senafe	Town Administration
5. Debarwa	Town Administration
6. Mendefera	Region and Sub-zone Town-"Baito"
7. Adiquala	Town Administration

Table 3.7: Enrolment in Debub Zoba

Level/grades	Total	Females	M/F Ratio
1. Primary (1-5)	83,289	36,150	57:43
2. Junior sec. (6-7)	9,901	3,728	62:38
3. Senior sec. (8-11)	7,750	2,433	69:31
Total/average	100,940	42,311	58:42

Source: Ministry of Education, Eritrea: Basic Education Statistics and Essential Indicators (1995/96), Asmara, November, 1996.

Table 3.8: Health Personnel in Debub Region

Health Personnel	Number	People Served
Medical Doctors	14	37,886
Eye Doctors	3	176,803
Maternity Nurses	15	35,803
Nurses	65	8,160
Laboratory Technicians	15	35,360
X-Ray Technicians	12	44,200
Pharmacists	3	176,803
Health Assistants	194	2,734
Others	16	-----

Source: Debub Zoba Social Development Department, 1997

Table 3.9: Number of Seats and Occupancy Rates of Hotels and Restaurants

Item	Hotels	Restaurants
1. No. of rooms	14	-
2. No. of seats	-	15
3. Occupancy rate	8	-
4. Turnover	-	15

Table 3.10: Number of workers in non household institutions

Type of Institution	Number of workers	
	Male	Female
1. Hotels	1	2
2. Restaurants	1	2
3. Shops	1	1
4. Gov. offices	182	90
4.1. Municipal	22	4
4.2. Sub-Zonal	69	15
4.3. Central Gov.	25	9
4.4. Pimary school	10	18
4.5. Senior secon.	23	7
4.6. Hosiptals	33	44
4.7. Others	0	3
Total	185	195

Table3.11: Percent of power failure, average capacity of own generator by type of establishment (for all towns)

Establishment	Capacity of own generator (Kw)	Power failure (%)
1. Hotels	7	0
2. Restaurants	6	17
3. Institutions	20	30
4. Shops	6	0
5. Factories	29	27
Total	17	14

Table 3.12: Women' organizations by type of establishments (percentage)

Establishment	Existence of Organization (percent)	Mahber	Ukub	NUEW	NUEY	Others (Ethio.)	No. of women Members
1. Hotels	50	0	0	27	0	10	2
2. Restaurants	67	0	0	64	0	9	2
3. Institutions	75	0	8	58	0	0	16
4. Shops	33	0	0	40	0	0	1
5. Factories	38	0	0	33	0	0	25
Total	55	0	2	45	0	4	9

Table 3.13: Average daily water consumption by type of establishments (in M3)

Establishment	House connection	Well	River/spring	Water tanker	Water vendor	Rain water
1. Hotels	4.22	0.20	-	1.63	0.06	0.03
2. Restaurants	2.86	-	-	1.00	0.13	0.02
3. Institutions	11.77	4.36	30.00	0.52	-	0.03
4. Shops	2.41	-	-	0.02	0.31	-
5. Factories	24.35	0.06	-	15.73	-	-
Average	9.34	0.92	6.00	3.76	.01	0.03
Total	45.61	4.62	30.00	18.90	0.50	0.08

Table 3.14: Percentage of Household average daily water consumption in dry and rainy seasons

Item	D	M	AQ	DK	SEG	AK	S
1. Dry Season							
1.1. <20 lit.	0	1.3	0	0.7	0	2.2	0
1.2. 20-39 lit.	13.9	10.7	9.1	16.6	10.4	20.1	24.7
1.3. 40-59 lit.	19.4	10.7	10.9	35.8	17.9	33.5	29.4
1.4. 60-79 lit.	27.8	32.0	21.8	11.3	23.9	22.9	28.2
1.5. 80-99 lit.	13.9	12.7	21.8	17.9	25.4	7.8	2.4
1.6. 100-119 lit.	5.6	11.3	14.5	6.6	10.4	3.4	10.6
1.7. 120-139lit.	2.8	2.0	5.5	0.7	3.0	2.8	2.4
1.8. >140	16.7	18.7	12.7	9.9	6.0	1.8	0
1.9. All D.season	100	100	100	100	100	100	100
2. Rainy Season							
2.1. <20 lit.	0	0	0	0	0	1.1	0.3
2.2. 20-39 lit.	5.6	6.7	7.3	9.3	7.5	13.4	10.4
2.3. 40-59 lit.	22.2	10.0	9.1	17.2	11.9	25.1	17.2
2.4. 60-79 lit.	25.0	16.7	21.8	25.8	16.4	29.1	23.2
2.5. 80-99 lit.	11.1	18.7	18.2	17.9	23.9	16.8	17.6
2.6. 100-119 lit.	8.3	16.0	25.5	12.6	23.9	6.7	16.5
2.7. 120-139lit.	5.6	4.0	3.6	2.6	4.5	3.4	5.9
2.8. >140	22.3	26.7	12.8	14.5	10.5	2.3	1.2
2.9. All season (Av.)	34.5	31.6	37.8	24.8	20.2	15.8	12.9

D= Debarewa; M= Mendefera; AQ= Adiquala; DK= Dekemhare; SEG= Segeneiti;
AK= Adikeyih; S= Senafe

CHAPTER 4 CURRENT SITUATION IN DEBAREWA

Table 4.1: Percentage Distribution of HH Heads By Sex, Size, Religion and Ethnic

HHs	Average
1. Size (person)	5.06
2. Gender (%)	
2.1. Male	61.1
2.2. Female	38.9
3. Religion (%)	
3.1. Muslims	5.6
3.2. Christians	94.4
4. Ethnic (%)	
4.1. Tigrigna	100
4.2. Saho	0
4.3. Tigre	0
4.4. Others	0

Table 4.2: Occupation of HHs

Occupation	Percentage of Households		
	Male	Female	All HHs
Agriculture	18.18	28.57	22.22
Animal Husbandry	4.55	0.00	2.78
Commerce	40.91	21.43	33.33
Industry	13.64	0.00	8.33
Government	31.82	14.29	25.00
Construction	9.09	0.00	5.56
Daily laborers	0.00	21.43	8.33
Drivers	0.00	0.00	0.00
Other	0.00	0.00	0.00
Unemployed	4.55	14.29	8.33

Table 4.3: Crop production (Qtls) and consumption (Percentage)

Type of crop	Production	Consumption
Sorghum	1.03	72.0
Millet	-	-
Barley	1.9	76.0
Taff	-	-
Wheat	4.0	100
Maize	-	-
Dagussa	-	-
Vegetables	16.5	36.5
Others	-	-

Table 4.4: Livestock and Agricultural land status of HHs

Item	Number owned	Percentage of HHs
A. Livestock number		16.7
1. Cows/ox	3.6	
2. Sheep/goat	28.0	
3. Horse/mule	2.0	
4. Donkey	1.2	
5. Camel	-	
6. Chicken	2.0	
7. Others	1.0	
B. Agricultural Land	Average hectare cultivated	Percentage of HHs
	0.7	25

Table 4.5: Average HH income by occupation, ethnic group and religion (Nfa)

Income by Occupation	Income by Ethnic background	Income by religion	Average HH Income
1. Agriculture 492	1. Tigigna 675	1 Muslims 825	675
2. Animalhusb. 1336	2. Saho	2. Christians 667	
3. Commerce 1112	3. Tigre	3. Others 675.8	
4. Industry 680	4. Others		
5. Government 865			
6. Construction 729			
7. Others 1003			
8. unemployed 588			

Table 4.6: Percentage of HHs by income group and average HH expenditure by item

HH income group (Nfa/Month)	Percentage	Expenditure Item (Nfa/month)	Amount (Nfa)
< 299	19.40	Food and beverages	46.20
300-599	27.80	Cloth and foot wear	6.60
600-999	11.90	Rent	4.90
1000-1499	5.60	savings and repayment	1.70
1500-1999	-	Electricity and energy	13.40
000-2999	8.30	Water	3.00
>3000	-	Education	1.20
		Health	1.50
		Transport	2.00
		Toiletries	4.80
		Culture/Travel, etc.	5.50
		Others	6.80

Table 4.7: Education status of HHs

Status	Percent
1. Student attendance rate	100
2. HH literacy status	
2.1. Literate	58.3
2.2. Illiterate	41.7
3. HH head educ. Level	
3.1. elementary school	52.4
3.2. junior secondary	23.8
3.3. senior secondary	9.5
3.4. college and above	0
3.5. other informal educ.	14.3

Table 4.8: Percentage of HHs by daily activity of women and girls

Activities	Percentage	
	Women	Girls
House keeping	100	30.56
Tending Livestock	00	00
Cottage industry	2.78	00
Commerce	25.0	2.78
Daily workers	8.33	-
Factory workers	2.78	-
Government workers	2.78	-
School	-	41.7

Table 4.9: Percentage of participation of adult women on educational session of social services

Type of session	Percentage
Water use	25.00
Sanitation	47.22
Child care	50.00
Family planning	22.22
Literacy	0.00

Table 4.10: Percentage of HH members participating in community organization

Activities	Percentage participation
Communal water points	0
Community toilets	0
Cottage indus.	0
Commercial activities	0
Social/cultural activities	76.6
Savings association	0
Others (PFDJ/NUEW)	89.3
Total	77.8

Table 4.11: Percentage of participation of adult women in communal activities

Activities	Percentage participation
Road	8.33
Public water point	0.00
Public toilet	0.00
Building	0.00
Crop harvest	0.00
Attending comm. Meetings	55.56
Soil and water conservation	33.33
Others (mainly cleaning street)	0.00
No participation	33.33

Table 4.12: Percentage of households by major HH problems

Type of problem	Percentage		
	Male	female	Total
1. Shortage of income	31.8	64.3	44.4
2. Inadequate medical service	0.0	0.0	0.0
3. Not enough schools	0.0	0.0	0.0
4. Shortage of water	45.5	28.6	38.9
5. Lack of electricity	22.7	7.1	16.7
6. Inadequate transport services	0.0	0.0	0.0
7. Lack of sanitation	0.0	0.0	0.0
8. Family relationships	0.0	0.0	0.0
9. Others(housing)	0.0	0.0	0.0

Table 4.13: Percentage of HHs by problems related to the existing water supply facilities

Problems of existing water supply facilities	Percentage of HHs
1. Not enough water	30.0
2. Water never reach house	0.0
3. Sometimes water stops	18.5
4. Deteriorating facilities	14.8
5. Not good water quality	37.0
6. Water price too expensive	33.3
7. Too distant water facility	44.4
8. Too long queuing time	29.6
9. Other (Labour needed to fetch)	0.0

Table 4.14: Average per capita water consumption for all seasons from all sources by income group

Income group (Nfa)	Daily per capita consumption (lits.)
< 299	16.1
300-599	24.7
600-999	35.5
1000-1499	21.7
1500-1999	-
2000-2999	74.4
>3000	-
Average	34.5

Table 4.15: Percentage of HHs affording to pay for water by income group

Income group	Percentage of HHs affording to pay (Nfa per) month						
	<5	5-9	10-14	15-19	20-29	30-49	>50
< 299	8.6	2.9	5.7	-	-	-	-
300-599	-	14.3	11.5	2.9	-	-	-
600-999	2.9	5.7	25.7	-	-	-	-
1000-1499	-	-	5.7	-	-	-	-
1500-1999	-	-	-	-	-	-	-
2000-2999	-	-	-	5.7	-	-	2.9
>3000							
Total	11.5	22.9	48.6	8.6	-	-	-

Table 4.16: Percentage of HHs affording to pay for community toilet by income group

Income group	Percentage of HHs affording to pay (Nfa/month)						
	<2	2-3	4-6	7-9	10-14	15-24	>25
< 299	-	-	-	-	-	-	-
300-599	-	-	16.7	-	16.7	-	-
600-999	-	16.7	16.7	-	16.7	-	16.7
1000-1499	-	-	-	-	-	-	-
1500-1999	-	-	-	-	-	-	-
2000-2999	-	-	-	-	-	-	-
>3000	-	-	-	-	-	-	-
Total	-	16.7	33.4	-	33.4	-	16.7

Table 4.17: Communal water points

Item	Percentage of HHs
1. Distance from comm. Water point	
1.1. < 90 m	6.7
1.2. 100-199 m	46.7
1.3. 200-399 m	40.0
1.4. > 400	6.7
2. Average Frequency (trips/week)	
2.1. Men	-
2.2 Women	11.4
2.3 Boys	6.5
2.4 Girls	15.7
3. Satisfaction with comm. Water point	
3.1. Satisfied	20.0
3.2. unsatisfied	80.0
4. Preference of unsatisfied houses	
4.1. House connection	58.3
4.2. Yard connection	41.7
4.3. Community water point	-

CHAPTER 5 STRATEGY ON PLANNING

Based on the assumptions developed in Chapter 5, section 5.2. the following is the result of the projected population for each of the seven towns under study.

Table 5.1: Population projection for the town of Debarwa

Year	Growth rate (%)	Base Population	No. of returnees	Total population
1997	-	-	-	4831
2000	5	5592	900	6492
2005	5	8286	1200	9486
2010	4.5	11822	1200	13022
2015	4.5	16227	1000	17227

Chart 6.1. : Organisational Structure of the MoLWE

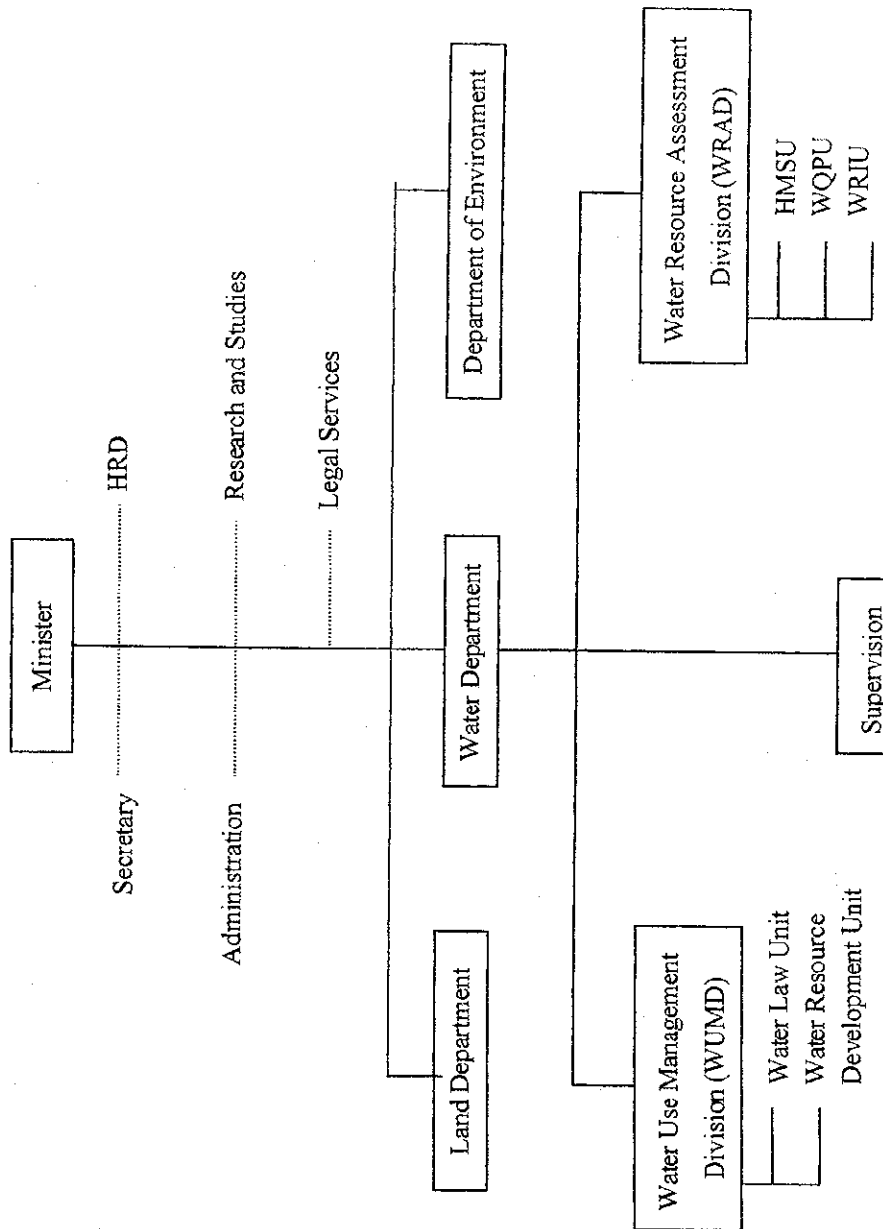
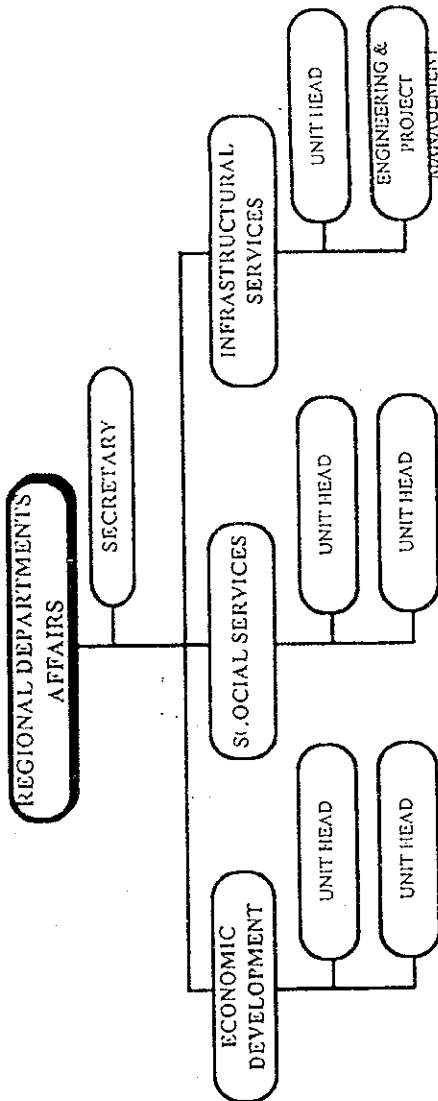


Chart 6.2: Organisational Structure of Regional Affairs Department, MoLG



Economic Development	1	Social Services	1	Infrastructural Services	1
*Unit Head	1	*Unit Head	1	*Unit Head	1
*Unit Head	1	*Unit Head	1	Eng. & Project Mgt.	1
Total	3	Total	3	Expert (Economist)	1
				Architect Planner	1
				Civil Engineer (structural)	1
				Total	6

(*Unit Head - Concernes with Agriculture, marine Resources, Land, & Environmental Protection)

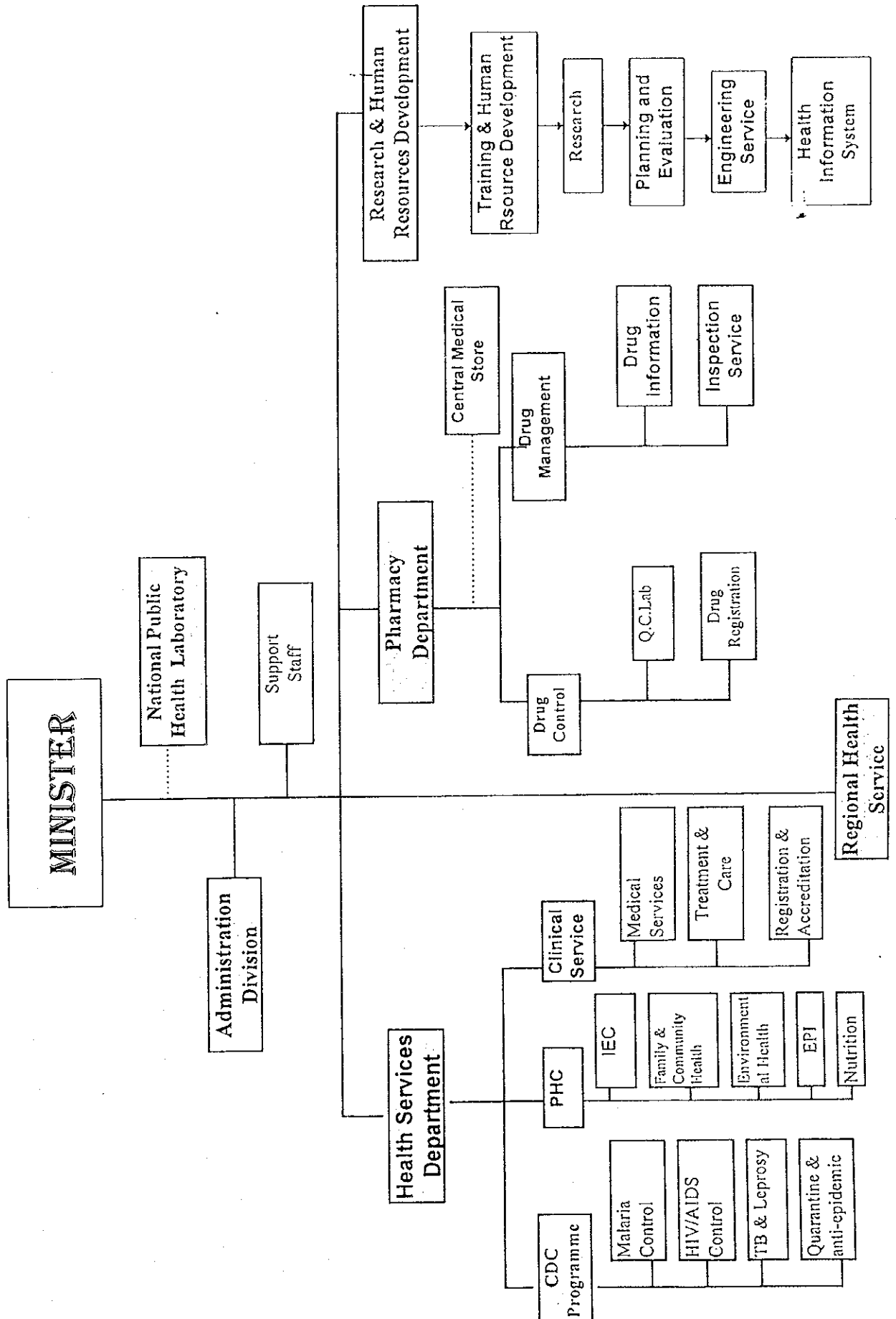
(*Unit Head - Concernes with Trade & Industry, Energy & Mines, Tourism, Finance, Investment & Lisence)

(*Unit Head - Concernes with Education, Health

(*Unit Head - Concernes with Labour & Human Welfare, Refugee & Rehabilitation).

(*Unit Head - Concernes with Transport, Communications & Water Resources).

Chart 6.3: Organisational Structure of The Ministry of Health



APPENDIX B

METEOROLOGY AND HYDROLOGY

List of Table

	Page
Table B-1 Monthly and Annual Rainfall(Debarwa).....	B-1

Table B-1 Monthly and Annual Rainfall(Debarwa)

Station: Debarwa

Unit: mm

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1927	na	na	na	58.8	4.5	13.9	205.4	180.9	35.0	na	na	na	na
1928	0.0	0.0	0.0	200.7	43.5	127.6	124.2	177.0	0.0	0.0	11.5	0.0	684.5
1929	0.0	7.0	6.5	132.0	10.0	76.5	298.9	229.7	25.5	7.0	8.5	41.0	842.6
1930	0.0	0.0	16.0	33.0	44.5	25.5	177.0	248.7	10.0	36.0	0.0	0.0	590.7
1931	0.0	0.0	8.0	19.7	59.5	66.0	232.5	225.5	21.5	16.9	0.0	0.0	649.6
1932	0.0	0.0	47.0	38.0	139.0	111.5	188.5	305.0	73.0	27.5	0.0	0.0	929.5
1933	0.0	2.5	0.0	20.5	45.5	125.0	232.5	392.0	152.5	3.0	55.0	0.0	1028.5
1934	0.0	0.0	14.0	89.8	102.0	37.0	na	na	na	na	na	na	na
1942	na	na	na	na	na	na	na	46.9	10.8	16.3	0.0	0.0	na
1943	0.0	0.0	1.2	40.5	41.5	48.2	165.7	125.1	53.9	33.8	0.0	0.0	509.9
1944	0.0	0.0	32.3	71.3	72.0	20.3	149.7	355.6	8.6	34.0	15.0	0.0	758.8
1945	0.0	0.0	0.0	45.0	72.7	3.0	74.0	239.5	na	0.0	35.0	0.0	na
1946	0.0	0.0	41.5	102.0	22.0	78.0	na	na	na	na	na	na	na
1992	0.0	0.0	6.0	21.0	33.0	21.0	143.8	172.0	24.0	49.5	13.0	0.0	483.3
1993	2.5	0.0	18.0	36.0	94.9	45.0	155.0	178.5	38.1	11.5	0.0	0.0	579.5
1994	0.0	0.0	3.0	0.0	48.5	83.5	131.0	195.0	82.0	20.0	0.0	0.0	563.0
1995	0.0	0.0	21.5	23.0	46.0	3.0	175.0	120.2	81.0	0.0	0.0	0.0	469.7
1996	0.0	0.0	36.0	71.0	119.0	231.7	112.8	224.7	12.5	0.0	47.5	0.0	855.2
Mean	0.2	0.6	15.7	59.0	58.7	65.7	171.1	213.5	41.9	17.0	12.4	2.7	658.5

Source: Sector Study, WRD

APPENDIX C
HYDROGEOLOGY

TABLE OF CONTENTS

CHAPTER 3 THE DEBUB REGION

3.1 Natural Conditions

C-1	HYDROGEOLOGICAL MAP	C-1
C-2	Legend on HYDROGEOLOGICAL MAP.....	C-2

CHAPTER 4 CURRENT SITUATION (Debarwa)

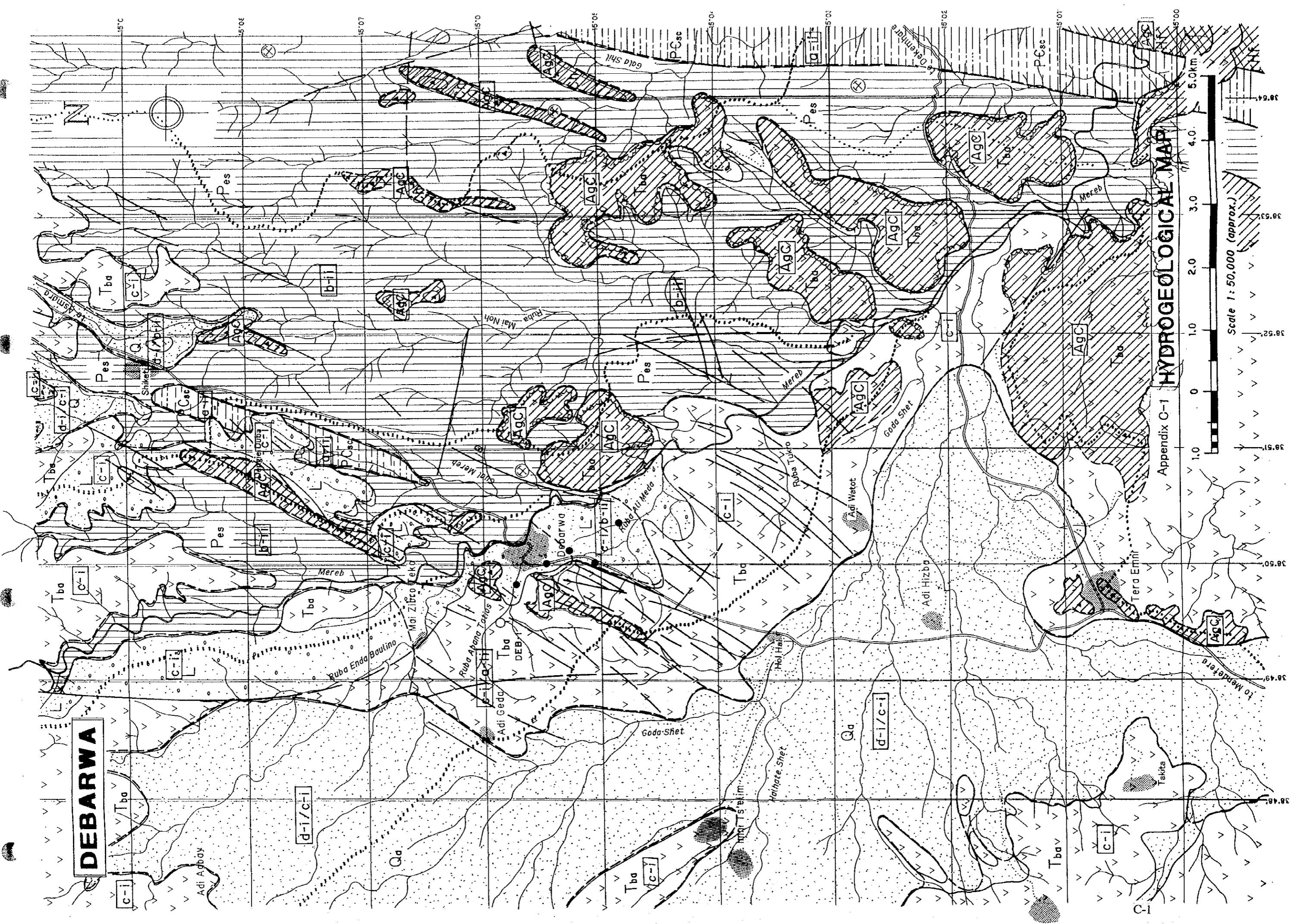
4.1 Natural Conditions

C-3	Geophysical Prospecting Works.....	C-3
C-3.1	Works volume	C-3
C-3.2	Location map of Geophysical Works.....	C-4
C-3.3	Results of Geophysical Prospecting Works	C-5
C-4	Test/Observation Well Drilling Works.....	C-6
C-4.1	Work volume	C-6
C-4.2	Location of drilling.....	C-7
C-4.3	Lithological Log	C-8
C-4.4	Results of Pumping Test.....	C-9
C-5	Water quality.....	C-10
C-5.1	Water qualities of Current Water Supply System	C-10
C-5.2	Water quality of Test/Observation Well	C-18
C-6	Groundwater Monitoring Data	C-22
C-7	Well Inventory Study	C-23
C-7.1	Well Inventory.....	C-23
C-7.2	Location map of wells	C-24

CHAPTER 7 PROJECT FEASIBILITY STUDY

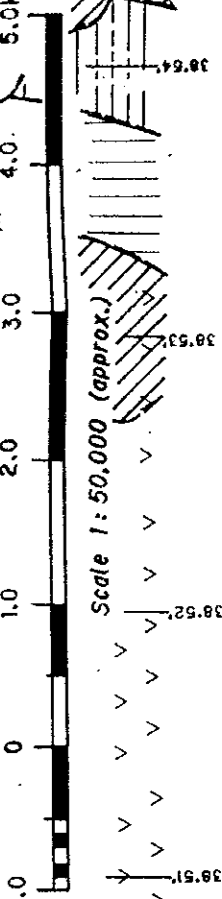
7.1 Groundwater Development Plan

C-8	Technical Specification for Production Well Drilling	C-25
C-9	Standard design of Production Well/Intake Facility	C-33



DEBARWA

Appendix C-1 HYDROGEOLOGICAL MAP



Scale 1:50,000 (approx.)

C-2 Legend on HYDROGEOLOGICAL MASP

Hydrogeological Legend

Geological Legend

	: Alluvial deposits	Quaternary	(a) Fissured aquifer of Basements
	: Laterite covers	Quaternary	: Granite
	: Basaltic volcanics	Tertiary	: Metamorphics
	: Trachytic volcanics	Tertiary	: Meta-volcanics
	: Adigrat Sandstone	Mesozoic	: Adigrat Sandstone
	: Sandstone	Paleozoic	: Paleozoic sandstone
	: Chert	Paleozoic	(c) Fissured aquifer of volcanics
	: Granite	Precambrian	: Basaltic volcanics
	: Granite (marginal phase)	Precambrian	(d) Intergranular aquifer of Sediments
	: Schist, Gneiss	Precambrian	: Alluvial deposits
	: Phyllite, Slate	Precambrian	: Colluvial deposits
	: Metavolcanic	Precambrian	Aquitard and Aquiclude
	: Dolomite	Precambrian	: Trachytics, Alkaline intrusives, Hornfels, Chert, and a part of basaltic volcanics.
	: Alkaline Intrusives	Tertiary	● : Existing borehole
	: Hornfels	Precambrian	○ : Test/Observation Well
			⋯ : Basin boundary

Appendix C-3 Geophysical Prospecting Works

C-3.1. Works Volume

(1) Methodology and Equipment

In this Study, three kinds of geophysical prospecting were introduced; those were Very Low Frequency Electromagnetic wave sounding (VLF-EM), Horizontal electric Sounding (HS) and Vertical Electric Sounding (VES).

Equipment used in this work were as follows:

- for VES and HS SYSCAL R-2 (Team)
 Terrameter SAS 300B (Dept. of Mines)
- for VLF ABEM WADI

(2) Works volume

Table C-3.1 Geophysical Prospecting Works (Original plan)

Township	Site	VLF	HS	VES
Debarwa	Near Adi Logo	-	2	8
	The Mereb	-	(2)	(5)
Mendefera	Upstream of power plant	-	-	15
	Downstream of power plant	-	-	10
Dekembhare	East of old run-way	8	-	30
Segeneiti	Valley at 3.5km SE	4	1	4
	Near the Municipality	4	1	4
	Valley at 4.5km W	-	2	-
Adi Keyih	Downstream of eastern valley	4	2	6
	Upstream of eastern valley	4	2	6
	Valley at 4.0km NW	-	2	-
Senafe	Afoma area	-	2	7
	Small valley at SE	4	2	-
Total		28 ^{lines}	16 ^{lines} (2 ^{lines})	90 ^{points} (5 ^{lines})

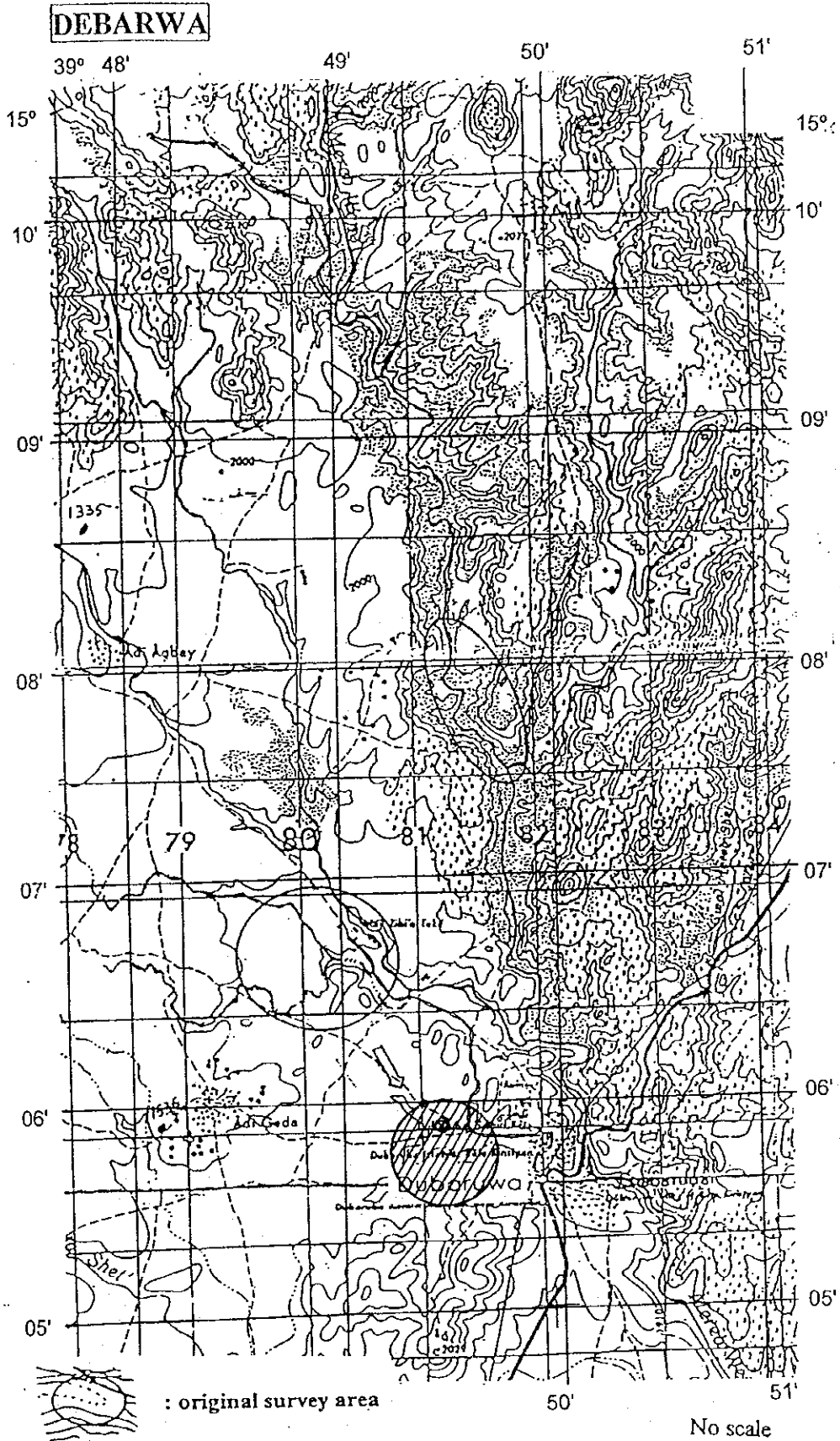
Note: () means small-scale survey.



Table C-3.2 Geophysical Prospecting Works (The final)

Township	Site	VLF	HS	VES	Remark
Debarwa	Near Adi Logo	-	2	9	Shift the site
	The Mereb	-	(4)	(5)	
Mendefera	Near the power plant	-	-	28	Unified
Dekembhare	East of old run-way	10	-	29	No change
Segeneiti	Valley at 3.5km SE	4	2	-	Shift the sites
	Near the Municipality	3	1	6	
	Valley at 4.5km W	5	2	8+(2)	
Adi Keyih	Upstream of eastern valley	-	4	6	Shift the sites
	Valley beneath the town	3	-	-	
	Valley at 4.0km NW	6	2	13	
Senafe	Afoma area	-	3	8+(8)	No change
	Small valley at SE	6	2	-	
Total		37 ^{lines}	18 ^{lines} (4 ^{lines})	107 ^{points} (15 ^{points})	

Note: () means small-scale survey.

C-3.2. Location Map of Geophysical Works



-  : original survey area
-  : modifies survey area

C-3.3. Summarized Results of Geophysical Prospecting Works

(1) Mereb River under flow

Investigation on the Mereb is purposed to know the potential of the Mereb's underflow.

The prospecting revealed the depth of river deposits is very small, only 1.0 to maximum 2.0m at ME-4 point. The results discouraged the intention to develop the underflow of the Mereb, because the Mereb might have insignificant underflow.

(2) Selection of drilling point

VES covered the main drainage course, and HS covered the side tributary come from the south.

Through the cross section analysis, it was easily recognized that a kind of structural line, possibly a fault, was passing through in E-W direction from GE-1 to GE-7 through GE-4.

General geological structure of the area is NNE-SSW direction. And if those structure were cut by the fault here, in E-W direction, groundwater of not only Ruba Abuna Tatios valley but widely of the main Mereb's may be caught here. Thus, a Test Well was proposed to drill here, at the point of GE-7.

Appendix C-4 Test/Observation Well Drilling Works

C-4.1. Work volume

(1) Type of Wells

In this Study, two types of well are set; "Test Wells" and "Observation Wells". The main purpose of the Test Well is to know its exact hydrogeological condition and to evaluate the aquifer potential of the site. The purpose of the Observation Well is to estimate the recharging function of an existing dam to the groundwater system downstream. Two dams, namely Kilowlie Dam in Mendefera and Afoma Dam in Senafe, were selected for this study.

(2) Work volume

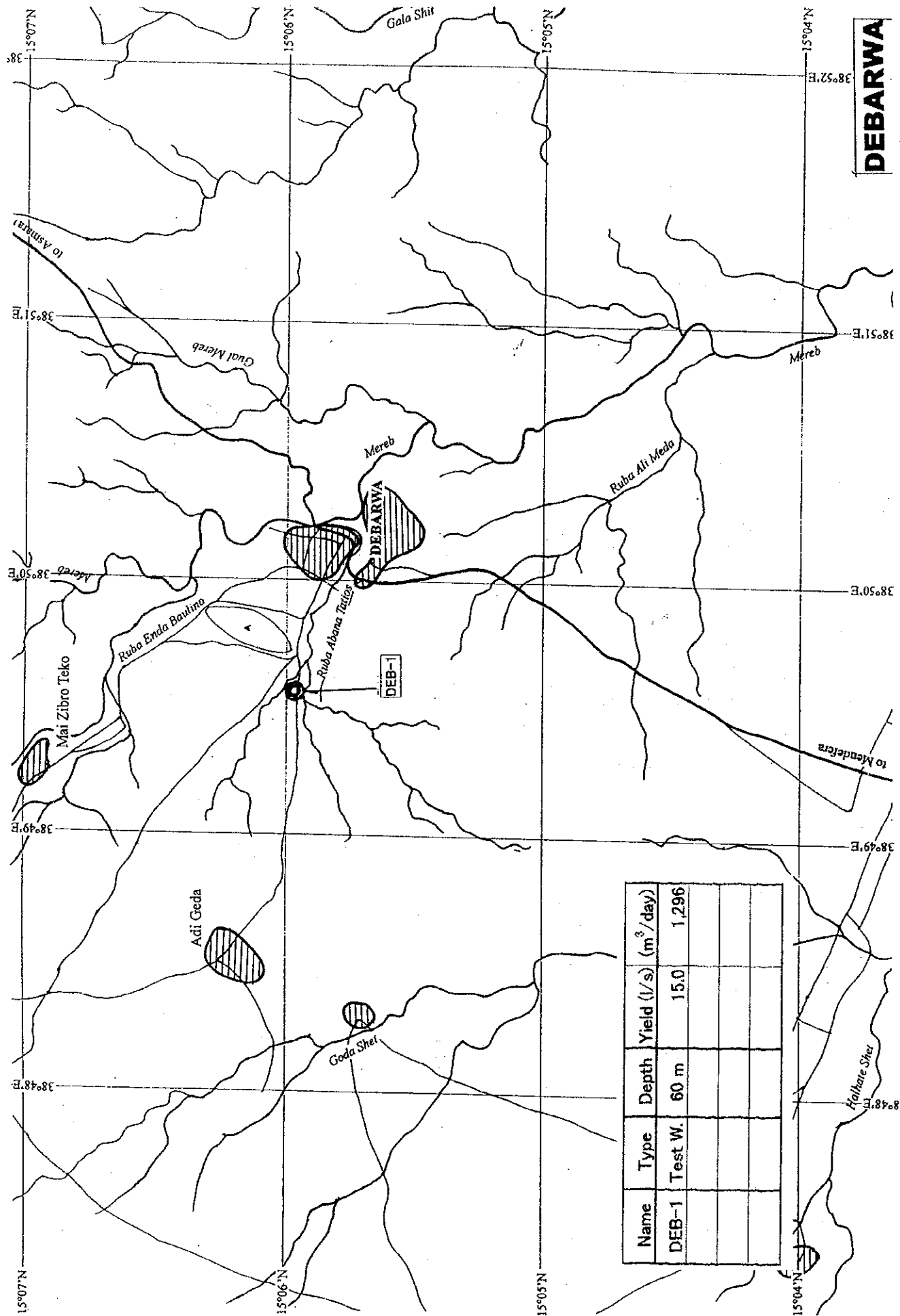
Table C.4.1 shows the final drilling plan. Those sites and the number of wells in each town were fixed but the depth of each drilling should be revised in accordance with the hydrogeological situation of the site.

Table C.4.1 Test/Observation Well Drilling Plan

Township	Site	Test Well	Obs.Well	Recorder*
Debarwa	West of the town	1 x 80m		1
Mendefera	Near the power plant Downstream of Kilowlie Dam	2 x 80m	2 x 30m	1 2
Dekemhare	East of old run-way	2 x 80m		2
Segeneiti	Valley at 3.5km SE Near the Municipality Valley at 4.5km W	1 x 60m 1 x 60m 1 x 60m		1
Adi Keyih	Upstream of eastern valley Valley at 4.0km NW	1 x 60m 1 x 60m		1
Senafe	Afoma Dam downstream		1 x 60m	1
Total		10 ^{wells} (700m)	3 ^{wells} (120m)	9 ^{wells}

● : Automatic water level recorder installatio

DEBARWA



Name	Type	Depth	Yield (l/s)	(m ³ /day)
DEB-1	Test W.	60 m	15.0	1,296

C-4.3 Lithological Log
DEB-1

GEDECC BOREHOLE DRILLING DATA:

Project: JICA		Village/Town: Debarwa		File No.: D - 025		
Drilling started: December 4, 1997		Zone: South		BH No.: DEB-1		
Rig type: Schramm		Casing: Temporary 12" PVC		Latitude: 38° 49' 31" E		
Depth drilled: 60 meters		From 0 To 12 m.		Longitude: 15° 50' 52" N		
Drilling completed: December 20, 1997		Casing: Permanent 6" PVC		Elevation:		
Filter slots: 2.00 mm.		From 0 to 60 m.		SWL: 5.25 meters		
Gravel type, size: Quartz, 10 mm.		Volume: 1.5 cubic meters		Drill bit size: 0-12m. 15" & 12-60m. 10" bit		
Geology:			Geophysical borehole logging: N.Gamma (M/Min)	Drilling speed: (m/hr)	Water struck: (L/sec)	Casing and Screen:
Depth (m)	Section:	Description:				
0		Unconsolidated top soil, medium grain, dark color, likely volcanic ash origin		5m/hr		Well cap 6" Lock Water level indicator Concrete pad 8.9mm plug Grout seal 6" Drill cut 7m
-10		Weathered, fractured & angular basalt fragments with kaolinite, qtz bearing reddish to brown color		7m/hr	First water struck 16 m.	Blank
-20		Rounded, sandy to gravel size. Laterite origin. reddish color.		3m/hr	1L/sec	Blank
-30						Screen
-40		Bulk composition laterite with angular milky white quartz fragments		5m/hr	2L/sec	5-10mm Quartz pack
-50		Same composition as above, more finer and pronounced reddish color		7m/hr		
-60		Composition laterite, with quartz. red to brown. grades to more finer at the depth of 60 meters.		5m/hr	8L/sec	Blank
-70					54m 6" PVC Blank 8.9mm plug 60m Not to Scale	

Prepared by: Amanuel G. Woldu

Date: Dec. 21, 1997

Note: These logs were taken by Hydrogeologist of GEDECC. Descriptions on lithology and depth of layer are slightly different with the one taken by Drilling Supervisor of the Team which are explained in the main text.

C-4.4 Result of Pumping Test

Pumping Test

Well Ident Deb-1		Description		
Obs. Well Distance [m] 0.08	Average Pump. Rate [m ³ /day] 1308.107	Duration [min] 4440.000	Initial Sat. Thickness [m]	
Results				
Transmissivity [m ² /day] 58.44519	Storage Coefficient	Leakance [1/day]	Estimation Error [m] 1.21	
Fit Method			Theis Method	

