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FEASIBILITY STUDY
ON
ADDIS ABABA FLOOD CONTROL PROJECT
IN
THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

FINAL REPORT
VOLUME II
MAIN REPORT

MAY 1998

NIPPON KOEI CO., LTD.

PACIFIC CONSULTANTS INTERNATIONAL

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
REGION 14 ADMINISTRATION
THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

THE STUDY
ON
ADDIS ABABA FLOOD CONTROL PROJECT
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FINAL REPORT

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(As of June 1997)

PREFACE

In response to a request from the Government of the Federal Democratic Republic of Ethiopia, the Government of Japan decided to conduct the Study on Addis Ababa Flood Control Project and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Ethiopia a study team headed by Mr. Tetsuro Shigeta of Nippon Koei Co., Ltd. three times between March 1997 and March 1998.

The team held discussions with officials concerned of the Government of Ethiopia, and conducted field surveys. After the study team returned to Japan, further studies were made and the Final Report was prepared.

I hope that this Report will contribute to the promotion of the project and to the enhancement of friendly relations between two countries.

I wish to express my sincere appreciation to the officials concerned of the Region 14 Administration of the Government of the Federal Democratic Republic of Ethiopia for their close cooperation extended to the study team.

May 1998

Kimio Fujita
President
Japan International Cooperation Agency

May 1998

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

Dear Mr. Fujita,

Letter of Transmittal

We are pleased to submit to you the Final Report on Addis Ababa Flood Control Project in the Federal Democratic Republic of Ethiopia.

The Study was carried out for a period of 14 months from March 1997 through May 1988. On the basis of the Study results, the Final Report has been prepared, presenting the formulated master plan for flood control to mitigate flood damage in Addis Ababa for the target year 2020, the selected priority projects, and the feasibility study of the priority projects.

As confirmed in the Report, the master plan has many beneficiaries in terms of human life and socio-economic activities, and the priority projects are technically viable and economically feasible. The implementation of the priority projects will create many direct benefits and simultaneously intangible and unquantifiable effects in the aspects of human lives, betterment of the living environment, and functional integrity of the capital city. Thus, the priority projects will contribute to the enhancement of human life. It is therefore recommended that the priority projects be realized at an earliest possible date as an important infrastructure development undertaking in Addis Ababa.

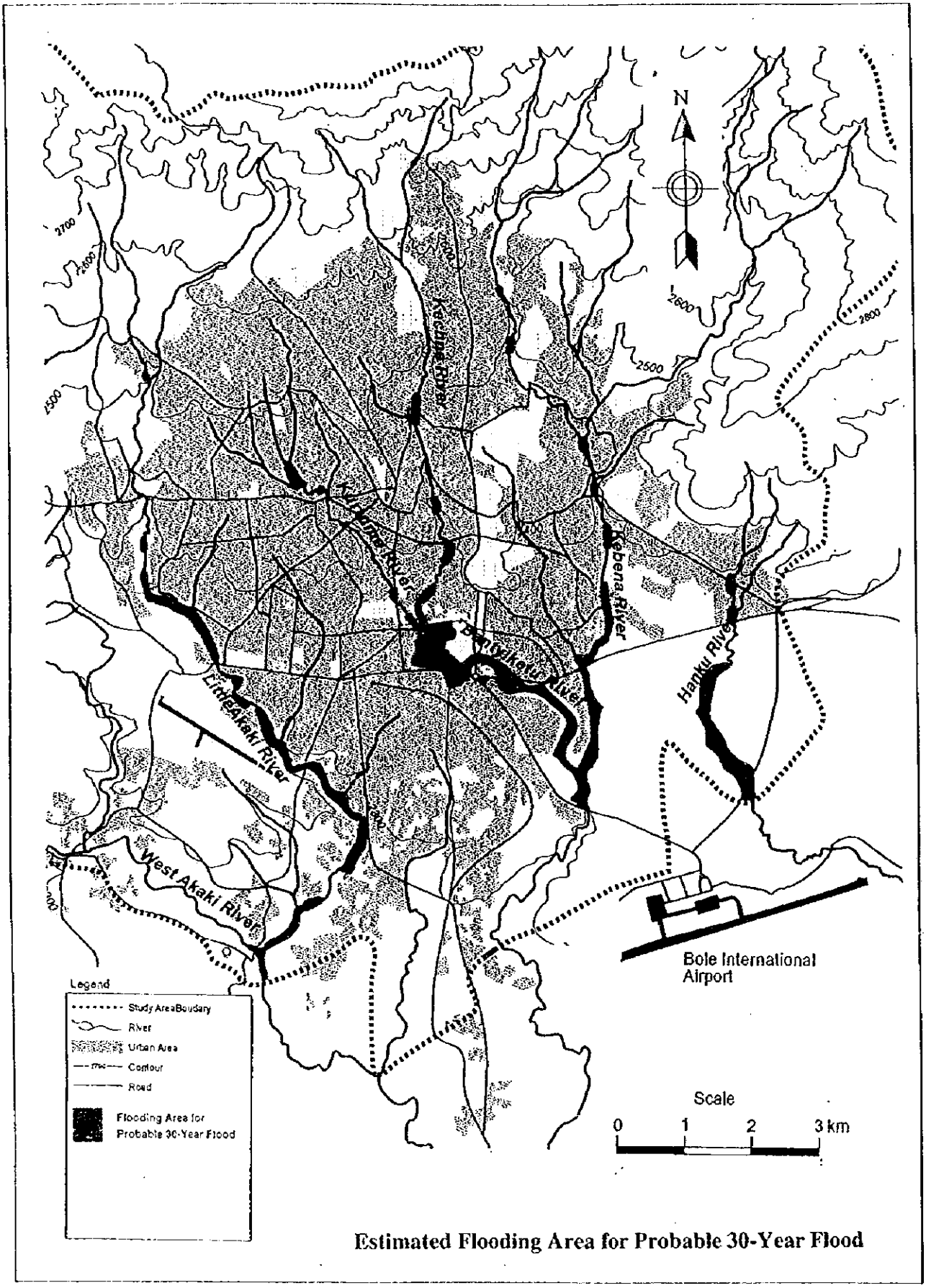
We wish to take this opportunity to express our sincere gratitude to your Agency, the Advisory Team for the Study and the Ministry of Foreign Affairs, Government of Japan. We also wish to express our deep gratitude to the Government of the Federal Democratic Republic of Ethiopia, the Region 14 Administration, the Embassy of Japan in Ethiopia, the JICA Ethiopia Office and JICA experts for close cooperation and assistance extended to us during our investigation and study.

Very truly yours,

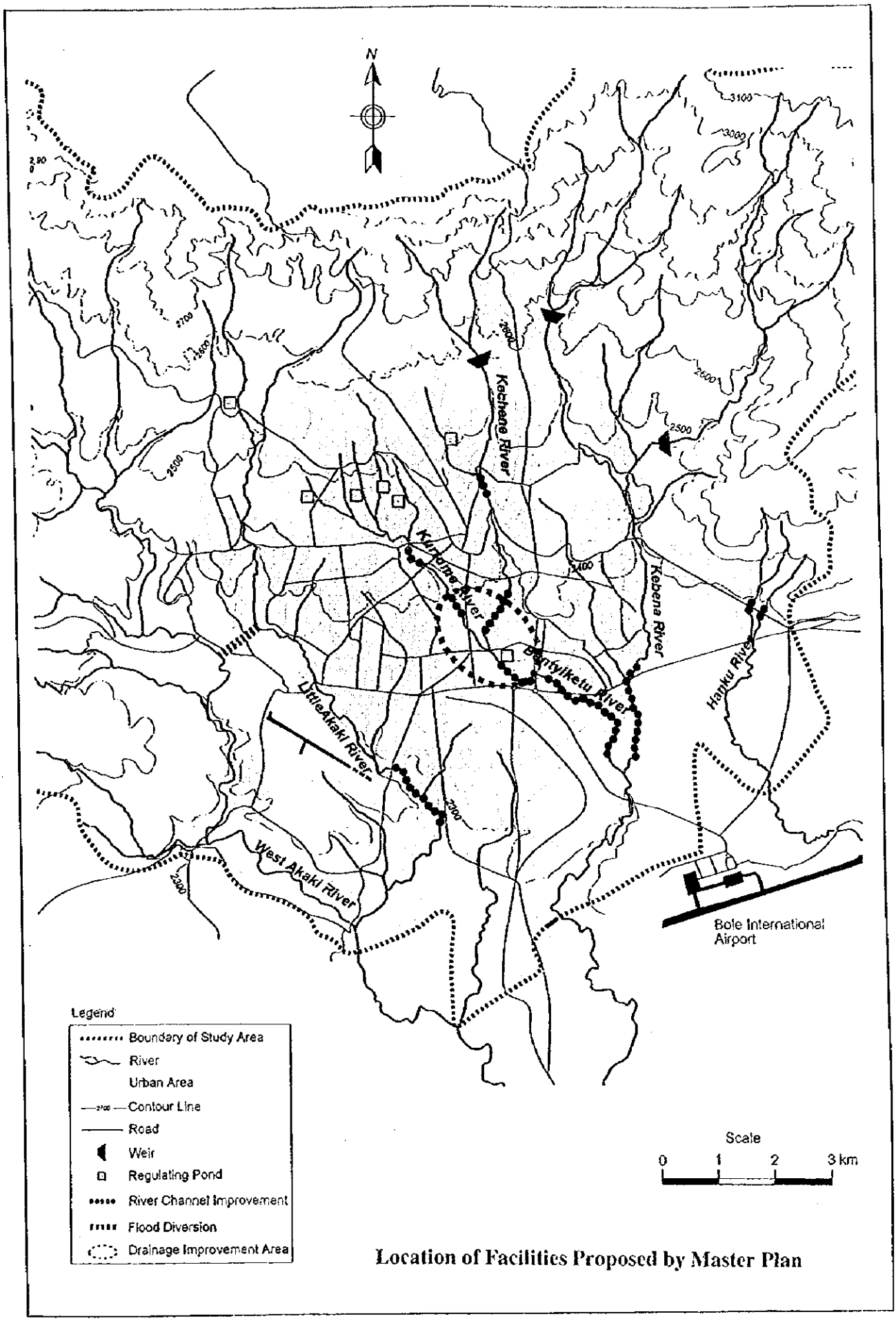
T. Shigeta

Tetsuro Shigeta
Team Leader
Addis Ababa Flood Control Project

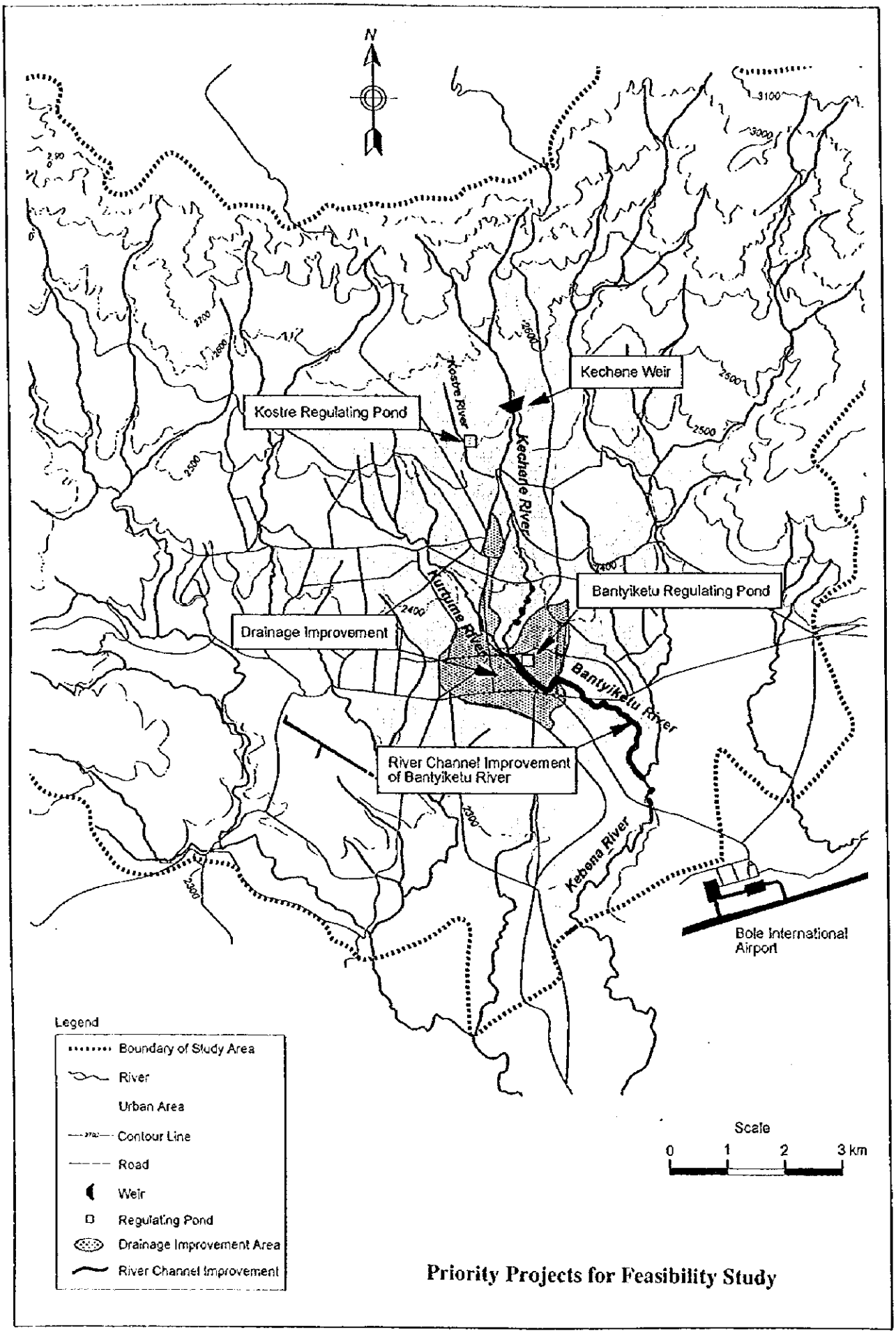
Location Map of Study Area



Estimated Flooding Area for Probable 30-Year Flood



Location of Facilities Proposed by Master Plan



Priority Projects for Feasibility Study

THE STUDY
ON
ADDIS ABABA FLOOD CONTROL PROJECT
IN
THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

COMPENDIUM

1. FRAMEWORK

(1) Study Area

Study Area	:	Catchment of all rivers draining the city of Addis Ababa (Area = 310 km^2)
Area for Flood Control Plan	:	Municipal Area of Addis Ababa (Area=168 km^2)
Area for Urban Drainage Improvement	:	Central Urban Area (Lowland) (Area = 2.61 km^2)

(2) Target Year : Year 2020

(3) Planning Conditions :

		Year 1997	Year 2020
Population in Study Area		1.8 million	4.4 million
Gross Regional Domestic Product (GRDP)		1,370 million Birr	8,150 million Birr
Land Use	Municipal Area	168 km^2	200 km^2
	Farmland / Forest / Others	142 km^2	110 km^2
Total		310 km^2	310 km^2

Design Discharge of Flood Control
Main Streams : Probable 30 year
Tributaries : Probable 20 year

Design Rainfall Intensity of Urban Drainage Improvement
Probable 1.5 year (30 mm/hr)

2. MASTER PLAN

2.1 STRUCTURAL MEASURES

For minimizing resettlement attributed to river channel improvement, flood retention facilities are furnished in upstream reaches. In principle, structures are designed on the basis of maintenance-free policies. Rainfall in the Study Area is of remarkably torrential one and about a half of such rainfall is recorded within 30 minutes, about 90 % within 60 minutes, their duration being not more than two hours, and such rainfall characteristics are also taken into account in design of structural measures.

Due to the lack of appropriate drainage facilities, the central urban area along both right and left banks of the Bantyiketu river suffers inundation almost every time when heavy rainfall occurs and mitigation measures of drainage congestion is formulated.

River System / River	Structural Measures			
	Weir	Regulating Pond	River Improvement	Others
Bantyiketu River System				
- Kechene River	1	1	1.0 km	Repair of a bridge abutment
- Kurtume River	0	4	0.8 km	-
- Bantyiketu River	1	1	4.5 km	Reconstruction of an aqueduct
- Urban Drainage	-	-	-	Construction of drainage ditches (L = 1.2 km)
Kebena River System				
- Kebena River	2	0	3.1 km	
Little Akaki River System				
- Little Akaki River	0	1	1.5 km	Flood Diversion Channel (L = 1 km)
West Akaki River System	(Only non-structural measures are applied to the river system.)			
Hanku River System				
- Hanku River	0	0	0.5 km	Reconstruction of 2 culverts

2.2 NON-STRUCTURAL MEASURES

Non-structural measures of the master plan consist of the river management, watershed management and flood risk management.

River Management	:	1)	Authorization of river zone
		2)	Social education of river and flood, and regulation of illegal activities
Watershed Management	:	1)	Reforestation
Flood Risk Management	:	1)	Flood Warning System
		2)	Flood Fighting
		3)	Storage of Storm Water

2.3 PROJECT COST

The project cost for the master plan amounts to 763.1 million Birr consisting of 751.2 million Birr for the structural measures and 11.9 million Birr for the non-structural measures.

Unit : Million Birr (Million US$)

River System	Bantyiketu	Kebena	Little Akaki	Hanku	Total
Project Cost	154.6	394.5	211.2	2.8	763.1
	(22.8)	(58.0)	(31.1)	(0.4)	(112.3)

2.4 EVALUATION OF PRIORITY BY RIVER SYSTEM AND PRIORITY PROJECTS

(1) Evaluation of Priority by River System

The structural and non-structural measures contemplated by the master plan has beneficial area of 105 km^2 and beneficial population of 1,345 thousand persons, and contribute to the stability of various functions fitted to the capital, Addis Abeba, and the well-being of local residents.

Priority by river system is determined based on the economic internal rate of return (EIRR), beneficial population, characteristics of land use and other factors. Among the four river systems, the Bantyiketu and the Little Akaki river systems are bestowed with sound economic viability, their EIRR being higher than 10 %.

River System	Bantyiketu	Kebena	Little Akaki	Hanku	Total
EIRR	11.7	3.5	10.6	7.2	10.8
Benefit/Cost	1.17	0.42	1.07	0.72	1.08
Beneficial area (km^2)	51	40	33	9	105
Beneficial Population (person)	610,000	280,000	420,000	35,000	1,345
Land Use	Mainly Governmental Agencies and Commercial Area	Mainly Moderately Built-up Area	Mainly Densely Built-up Area	Mainly Moderately Built-up Area	-
Priority	1	4	2	3	-

(2) Priority Projects

The Bantyiketu river system including the Kechene and the Kurtume rivers is evaluated with the highest priority among the four river systems. The priority projects are selected as a combination of structural and non-structural measures with the highest priority in terms of economic viability and social impacts in the Bantyiketu river system.

Structural measures

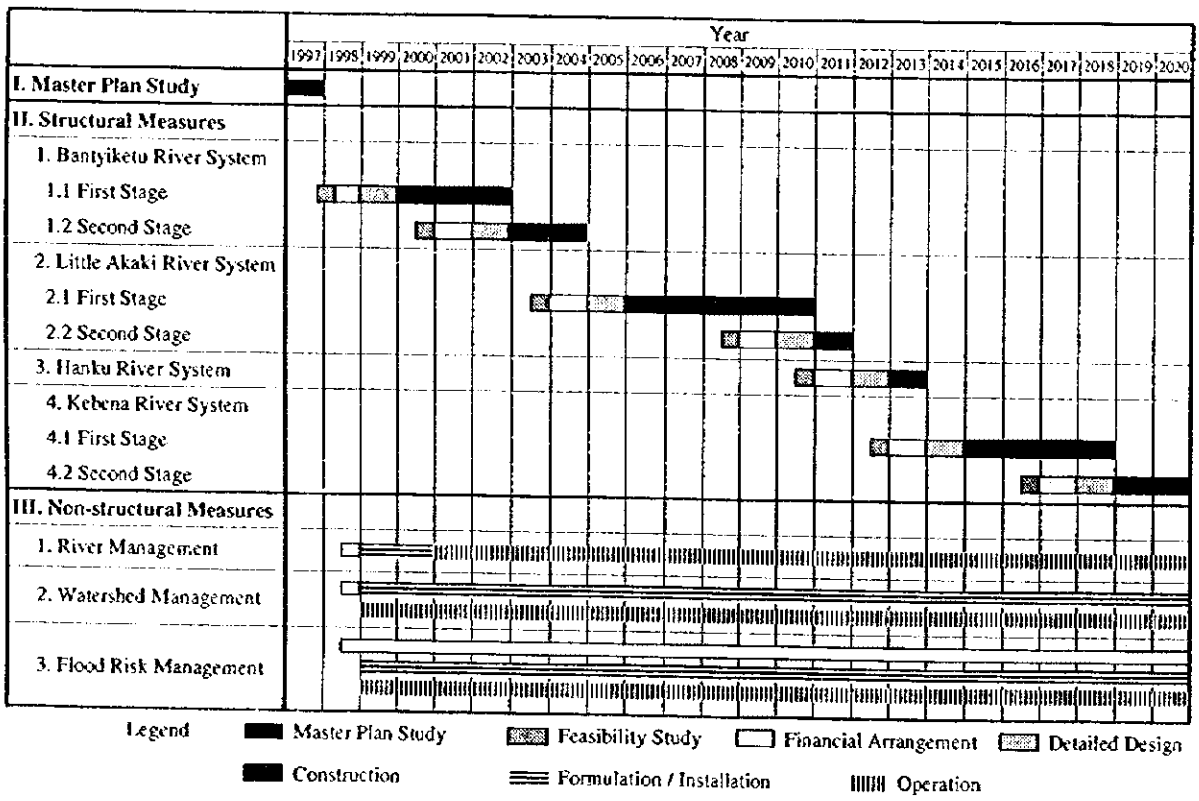
- Objective rivers : Bantyiketu and Upper Kechene rivers
- Flood Control Facilities : 1 weir, 2 regulating ponds, River channel improvement of Bantyiketu river, Associated works
- Urban Drainage Facilities : Central urban area (Lowland)

Non-structural measures

- River Management : 1) Authorization of river zone
  2) Social education of river and flood
- Flood Risk Management : 1) Flood Warning System
  2) Flood Fighting System

2.5 IMPLEMENTATION PLAN

The implementation plan of the structural measures are formulated in compliance with priority order by river system, periods of pre-construction and construction stages, and disbursement schedule of project cost. All the construction works will be completed in the end of 2020. The non-structural measures will also be implemented along with the structural measures until the year 2020.



Implementation Plan of Master Plan Projects

3. FEASIBILITY STUDY

3.1 FLOOD CONTROL PROJECTS

(1) Structural Measures

(a) Bantyiketu River System

The major features of the structural measures for the Bantyiketu river system are summarized as follows.

River Channel Improvement		
Flood wall/Slope protection	:	11 locations, L = 2.3 km
River excavation	:	4 locations, L = 2.0 km
Earth dyke	:	1 location, L = 100 m
Reconstruction of an aqueduct	:	1 location, L = 20 m
Regulating Pond		
Bantyiketu regulating pond	:	Regulating volume = 73,000 m^3, Impounding area = 29,900 m^2
Kostre regulating pond	:	Regulating volume = 26,000 m^3, Impounding area = 6,500 m^2
Reservoir by Weir		
Kechene weir	:	Concrete gravity weir, H = 19.5 m, Regulating volume = 96,000 m^3, Non-emergency spillway : 3 orifices (1.2m x 1.2m)

(b) Urban Drainage

The urban drainage improvement plan is designed to prevent inundation of the objective area of 2.61 km^2 when rainfall with intensity of 30 mm/hour takes place.

Drainage Basin	Drainage Area (km^2)	Design Discharge (m^3/sec)	Dimensions of Drainage Ditch	
Northern Basin	0.25	0.7	D = 1.1 m	W = 1.3 m
Eastern Basin	0.73	0.5 – 1.5	D = 1.2-1.5 m	W = 1.3 m
West-southern Basin	1.63	0.7 – 1.4	D = 1.9-2.2 m	W = 1.3 m
Total	2.61	7.4		

(2) Non-structural Measures

For amplifying the effect of structural measures, Addis Ababa River Board (AARB) and Addis Ababa River Management Authority (AARMA) will implement non-structural measures as follows.

River Zone	:	For proper management of rivers and river structures, open space, 5 meters in width, is provided along both banks of rivers.
Flood Warning System	:	Rainfall gauging stations are installed at 3 locations in upstream areas of the basin. Rainfall data observed is sent to and analyzed by AARMA.
Flood Fighting System	:	Communities subordinate to Kebeles undertake flood fighting under direction of AARB.
Social Education	:	Kebeles and communities hold seminars for local people under direction AARB and AARMA. The seminars concern river management, flood and illegal activities such as waste disposal, private use of riparian areas.
Reforestation	:	AARB and AARMA advise on reforestation undertaken by the agricultural bureau of Region 14 Administration

3.2 ORGANIZATION AND INSTITUTION

Addis Ababa River Board (AARB) to be newly organized under Economic Sector of Region 14 Administration is a sole organization responsible for management of all rivers in Region 14 Administration. Under AARB, Addis Ababa River Management Authority (AARMA) is to be established with its roles involving management and maintenance of rivers, investigation, planning, design and construction of projects, legislation of river management, as well as flood warning system and flood fighting system.

Responsibilities and undertaking in new organizations are as follows.

Addis Ababa River Board (AARB)	:	(1)	Coordination with offices and agencies concerned
		(2)	Establishment of new departments of AARMA
		(3)	Budgetary control
		(4)	Land acquisition
Addis Ababa River Management Authority (AARMA)	:	(1)	River management
		(2)	Maintenance of river and river structures
		(3)	Issuing of Flood Warning
		(4)	Flood fighting
		(5)	Investigation, planning and design of river projects
		(6)	Tendering of river projects
		(7)	Construction supervision
		(8)	Resettlement
		(9)	Social education for local people
Local Communities	:	(1)	Assistance in maintenance of river structures
		(2)	Notification of flood warning
		(3)	Flood fighting

3.3 PROJECT COST

Total project cost of the priority projects is estimated at 104.4 million Birr (equivalent to 15.4 million US$).

Structural Measures:

Unit : Million Birr (Million US$)

Weir/Regulating Pond			River Channel Improvement			Urban Drainage	Total
Kechene Weir	Kostre Pond	Bantyiketu Pond	Flood wall / Slope protection	River Excavation	Associated Works		
27.6 (4.1)	8.8 (1.3)	18.6 (2.7)	19.5 (2.9)	3.9 (0.6)	1.2 (0.2)	18.3 (2.7)	97.9 (14.4)

Non-structural Measures:

Unit : Million Birr (Million US$)

River Management		Flood Risk Management		Total
River Zone	Social Education	Flood Warning System	Flood Fighting	
2.9 (0.4)	0.1 (0.01)	2.3 (0.34)	1.2 (0.2)	6.5 (1.0)

3.4 PROJECT EVALUATION

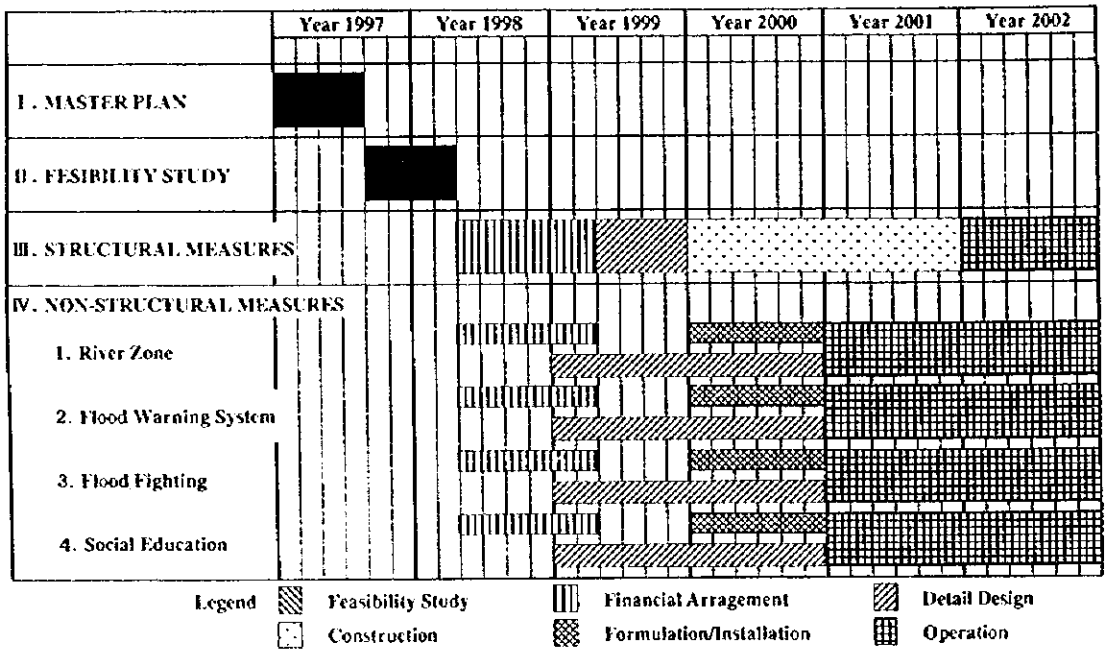
The priority projects have beneficial area of 43 km^2 and beneficial population of 470 thousand persons at the target year 2020, being bestowed with high economic internal rate of return (EIRR) of 12.8 %. Due to the implementation of the priority projects, only four houses are to be resettled, and there exist neither national parks nor archeological resources affected.

(1)	Annual Average Benefit	:	13.6 million Birr
(2)	EIRR (%)	:	12.8
(3)	Benefit/Cost	:	1.29
(4)	Beneficial area (km^2)	:	43
(5)	Beneficial Population (person)	:	470,000 (Target Year 2020) and 200,000 (Year 1997)
(6)	Impact on Natural Environment	:	Negative benefits are negligibly small.

In addition, the priority projects create a lot of intangible and nonquantifiable benefits such as contribution to the stability of various functions fitted to the capital, Addis Abeba, and the well-being of local residents, resulting from the distinctive improvement of living conditions and public health.

3.5 IMPLEMENTATION PLAN

After this feasibility study, it is expected that the implementation will be commenced from the year of 1999 after some period of financial arrangement. Proposed implementation plan of the priority projects is shown below.



Implementation Plan of Priority Projects

4. CONCLUSIONS AND RECOMMENDATIONS

(1) Advance toward Implementation of Structural and Non-structural Measures Contemplated by Master Plan

The amount of flood damages in the Region 14 Administration is soaring year by year with the drastic increase of population and infrastructures. It is recommended that the priority projects be first launched among projects proposed by the master plan, and that the rest of the master plan projects be continuously implemented according to the implementation plan of the master plan projects from the view point of local economic conditions and social welfare.

(2) Early Implementation of Priority Projects

Flood control measures of the Bantyiketu river and the upper Kechene river are chosen for the priority projects. 11 % of total population of the Region 14 administration enjoy direct or indirect benefits created by the priority projects, and more intangible and unquantifiable benefits are expected. The priority projects indicate high economic viability with Economic Internal Rate of Return (EIRR) of 12.8 % and Benefit-Cost ratio of 1.29 and their early implementation is strongly recommended.

STUDY
ON
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MAIN REPORT

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ABBREVIATIONS

Measures

Length

mm	millimeter
cm	centimeter
m	meter
km	kilometer

Area

m^2, sq.m	square meter
ha	hectare
km^2, sq.km	square kilometer

Volume

l , lit.	liter
m^3, cu.m	cubic meter

Weight

mg	milligram
g	gram
kg	kilogram
t	ton

Time

s, sec	second
min	minute
hr	hour
d	day
yr	year

Money

Birr	Ethiopian Birr
US$	U. S. Dollar
J. Yen	Japanese Yen

Electricity

V	volt
A	ampere
KV	kilovolt
KW	kilowatt
KWh	kilowatt hour
KVA	kilovolt ampere

Derived Measures

mg/l	milligram per liter
m/s, m/sec	meter per second
m^3/sec, cu.m/sec	cubic meter per second
m^3/day, cu.m/day	cubic meter per day

Other Measures

%	percent
°C	degree centigrade
BOD	biochemical oxygen demand

Organizations

OAU	Organization of African Union
JICA	Japan International Cooperation Agency
NMSA	National Meteorological Services Agency of Ethiopia
MEDAC	Ministry of Economic Development and Cooperation
MUDH	Ministry of Urban Development and Housing
NUPI	National Urban Planning Institute
WUDB	Works and Urban Development Bureau of Region 14 Administration
CSA	Central Statistical Authority
ADF	African Development Fund
IDA	International Development Association
NEPA	National Environmental Protection Authority
AFCPO	Addis Ababa Flood Control and Prevention Project Office of the Region 14 Administration
AAWSA	Addis Ababa Water Supply and Sewerage Authority of the Region 14 Administration
BCEOM	Bureau Central D'etudes Pour Les Equipments D'outer-Mer
NDPPC	National Disaster Prevention and Preparedness Committee
NCEW	National Committee for Early Warning
RDPPC	Regional Disaster Prevention and Preparedness Committee
WDPPC	Wereda Disaster Prevention and Preparedness Committee
WRDC	Wereda Disaster Relief Cell
FRDE	Federal Government of Ethiopia
AARB	Addis Ababa River Board (proposed)
AARMA	Addis Ababa River Management Authority (proposed)
ECA	European Community of Africa
UNDP	United Nations Development Program
UNICEF	United Nations International Children's Emergency Fund

UNESCO	United Nations Educational, Scientific, and Cultural Organization
ILO	International Labor Organization
NGO	Non-governmental Organizations

Others

S.N.N.P.R.	Southern Nations Nationalities and People's Region
PEP	Public Expenditure Program
PIP	Public Investment Program
GDP	Gross Domestic Product
GRDP	Gross Regional Domestic Product
ITCZ	Inter Tropical Convergence Zone
ALDI	Industrial Lead by Agricultural Development
EIRR	Economic Internal Rate of Return
B/C	Cost-Benefit Ratio
NPV	Net Present Value
IEE	Initial Environmental Examination
EIA	Environmental Impact Assessment
F. C.	Foreign Currency
L. C.	Local Currency
O/M, O&M	Operation and Maintenance
El.	Elevation
DHWL	Design High Water Level

CHAPTER 1 INTRODUCTION

1.1 Background of the Study

Addis Ababa is the capital city of the Federal Democratic Republic of Ethiopia. The city is the center of politics and socio-economy of the country as well as an important city in Africa where the Organization of African Union (OAU) is established.

The population in Addis Ababa increased from 1.4 million in 1984 to 2.1 million in 1994 with an average annual growth rate of 3.5%. The various urban properties and infrastructures have been also developed as the population growth. In addition, riparian areas have been densely built-up with residential houses even in flood prone areas. As a result, potential flood damages are inevitably increasing year by year. The city has suffered from serious flood damages, especially in the floods in the years 1978, 1994 and 1995. These floods caused serious social disturbances such as loss of human lives and houses, damages to various infrastructures and paralysis of socio-economic activities. However, any effective flood control measures have not been implemented due to lack of comprehensive master plan for flood protection covering the whole city area in Addis Ababa.

Taking the aforesaid situation into account, the Federal Government of Ethiopia requested to the Government of Japan to formulate a flood control master plan in Addis Ababa. In response to the request of the Government of Ethiopia, the Government of Japan dispatched the Preparatory Study Team of the Japan International Cooperation Agency (JICA). The Scope of Work for the Study on Addis Ababa Flood Control Project (hereinafter referred to as 'the Study') was mutually agreed between the Region 14 Administration of the Government of Ethiopia and JICA on 11October 1996.

The Study Team for the Addis Ababa Flood Control Project was organized in accordance with the contract between JICA and the joint venture of Nippon Koei Co., Ltd. and Nikken Consultants, Inc. in March 1997. The Study was commenced in the end of March 1997 and is to be finalized in the end of May 1998.

1.2 Objectives and Scope of the Study

1.2.1 Objectives

The objectives of the Study are given as follows in accordance with the Scope of Work.

a) Formulation of a flood control master plan in Addis Ababa to the target year 2020 and selection of priority project(s) from the said master plan,
b) Feasibility study for priority project(s), and
c) Transfer of technology to Ethiopian counter part personnel in the course of the Study.

1.2.2 Study Area

The Study Area covers all the catchment of the rivers draining the city of Addis Ababa as shown in Figure 1.1. The total area is estimated approximately 310 km^2. The Study Area is classified into the five river systems and residual catchments as listed in Table 1.1.

Table 1.1 River Systems in the Study Area

River System	Catchment Area (km^2)
1. Bantyiketu River System	29.3
Kechene River Basin	(13.6)
Kurtume River Basin	(10.3)
Bantyiketu River Basin	(5.4)
2. Kebena River System	59.8
Upper Kebena River Basin	(54.8)
Lower Kebena River Basin	(5.0)
3. West Akaki River System	172.2
4. Little Akaki River System	30.8
5. Hanku River System	11.1
6. Other	6.5
Total	309.7

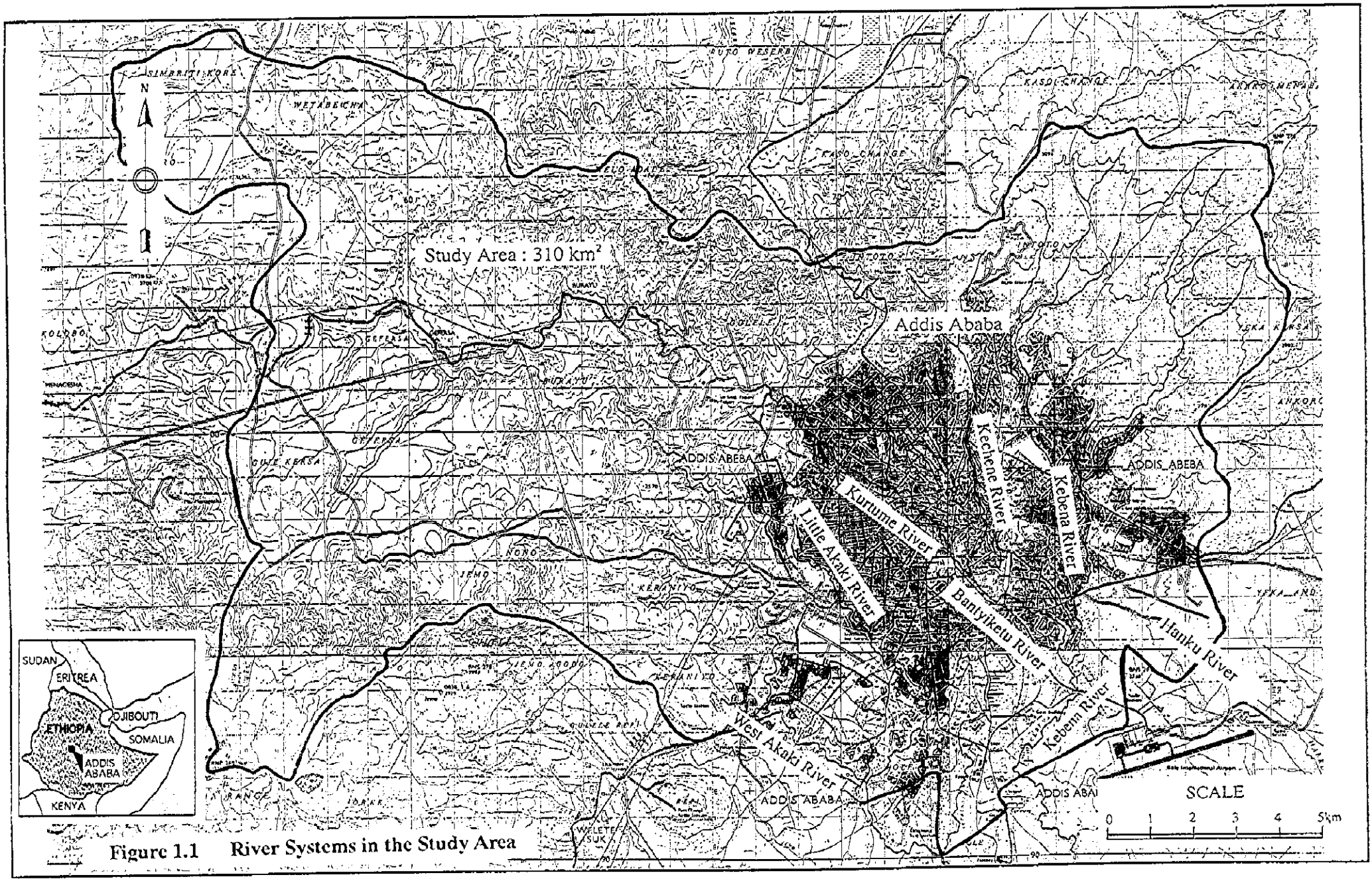


Figure 1.1 River Systems in the Study Area

1.2.3 Scope of Work

The Study is carried out for the period of 15 months including the following two phases.

- Phase 1: Master Plan Study for Addis Ababa Flood Control Project, and
- Phase 2: Feasibility Study for Priority Project(s).

The work items in the overall period of the Study are given as follows.

Table 1.2 Scope of Work

Phase 1: Master Plan Study for Addis Ababa Flood Control Project (March 1997 – October 1997)

Stage	Period	Work Item
Preparatory Work in Japan	From March 1997 To April 1997	- Preparation of Inception Report
First Work in Ethiopia	From April 1997 To August 1997	- Presentation of Inception Report - Collection and analysis of data and information - Field Reconnaissance and investigation - Studies on master plan - Preparation and presentation of Progress Report (1)
First Work in Japan	From August 1997 To October 1997	- Formulation of master plan - Selection of priority project(s) - Preparation of Interim Report

Phase 2: Feasibility Study for Priority Project(s) (November 1997 – May 1998)

Stage	Period	Work Item
Second Work in Ethiopia	From November 1997 To January 1999	- Presentation of Interim Report - Supplemental data collection and investigation - Study on planning conditions - Preparation and Presentation of Progress Report (2)
Second Work in Japan	From January 1998 To March 1998	- Preliminary design of facilities - Construction plan - Operation and maintenance plan - Cost Estimate - Project evaluation - Project implementation plan - Preparation of Draft Final Report
Third Work in Ethiopia	March 1998	- Presentation of Draft Final Report
Third Work in Japan	May 1998	- Preparation of Final Report

1.3 Organization for the Study

An organization for the Study consists of the Study Team, the JICA Advisory Committee for the Study and Ethiopian counterpart groups.

The Study Team comprises the eight Japanese experts and six Ethiopian counterparts. JICA established the Advisory Committee for the Study throughout the study period. On the other hand, the Steering Committee of the Study is organized in the Region 14 Administration. The members of the Study Team, the Advisory Committee and the Steering Committee are shown in Table 1.3.

Table 1.3 Organization of the Study

Study Team and Counterparts

Assignment	Japanese Experts	Ethiopian Counterparts
Team Leader	Mr. Tetsuro Shigeta	Mrs. Tekabu Workagegnehu
Flood Control Planner	Mr. Takayuki Nobe	Mr. Teferi Tadesse
Hydrologist/Hydraulic Engineer	Mr. Masayuki Ogino	Mrs. Helen Hailemerian
Drainage Engineer/Sociologist	Mr. Toshikatsu Imai	Mrs. Asrate Asfaw
Socio-Economist	Mr. Noritoshi Maehara	Mr. Zekiros Berhane
Structural Planning and Design Engineer	Mr. Nobuhiko Fukuta	Mrs. Helen Hailemerian
Construction Plan and Cost Estimator	Mr. Kozo Yamada	Mr. Teferi Tadesse
Survey Expert	Mr. Kazuhiro Ishizuka	Mr. Gossay Mohamed

JICA Advisory Committee

Designation	Name	Agency
Chairman	Mr. Masayuki Watanabe	Development Specialist, JICA
Advisor	Mr. Toshio Takami (for Phase 1)	Deputy Director, River Improvement and Management Division, River Bureau, Ministry of Construction
Advisor	Mr. Kei Kudo (for Phase 2)	Deputy Director, River Improvement and Management Division, River Bureau, Ministry of Construction

Steering Committee

Designation	Name	Position
Chairman	Mr. Astatke Chaka	Head of Economic Sector
Acting Chairman	Mr. Abebe Kebede	Economic Adviser of the President
Member	Mrs. Meselech Berhan (for Phase 1)	Executive Committee Member of Economic Sector
Member	Mr. Abebe Zeluel	Acting Head of Economic Sector Head of Transport Bureau
Member	Dr. Solomon Berhe	Head of Planning and Economic Development Bureau
Member	Mr. Solomon Tesfay (for Phase 1)	Head of Works and Urban Development Bureau
Member	Mr. Belete Bekele (for Phase 2)	Acting Vice-Head of Works and Urban Development Bureau
Member	Mr. Teshome Nagash	Head of International Relation and Cooperation Bureau
Member	Mr. Tesfaye Mengesha	Head of Master Plan Development Bureau

CHAPTER 2 PRESENT CONDITIONS OF THE STUDY AREA

2.1 Natural Situation

2.1.1 Topography

The Study Area of 310 km^2 extends to the central part of the West Ethiopian plateau. The mountain ridge extending over the north and east of the Study Area is called as Intoto Ridge. Altitudes of the ridge range from 2,600 to 3,200 meters. Flat and undulating topography spreads to the southern slopes of Intoto Ridge. The city of Addis Ababa a situates on this topography with altitudes from 2,700 to 2,350 meters. The lands of the urban area are deeply dissected by numerous valleys formed by the five major river systems running towards south through such valleys. Fairly flat topography gradually slopes to the further southeasterly direction.

2.1.2 Geology

Figure 2.1 shows geological map in Addis Ababa. The Study Area is almost covered by volcanic materials. The northern part of the Study Area called as Intoto ridge is composed of Ternaber basalts. This is called as Intoto Cilcic and covered with the volcanic topsoil materials of about 1 to 2 meters thick. The urban area is composed of younger basalts called as Addis Ababa basalts than that of Intoto ridge, and covered with volcanic topsoil materials.

On the other hand, the west part of the Study Area, which belongs to the younger age stratum than the above-mentioned areas, is mainly composed of Trachey basalts. In the Bole area, a kind of basalt called as Ignimbrites is partly found. In general, topsoil materials in the western part of the Study Area is characterized by thick and soft compared with those of the northern and eastern parts, except the upstream area of the Kechene river. Therefore, the West Akaki river have fairly deep valleys.

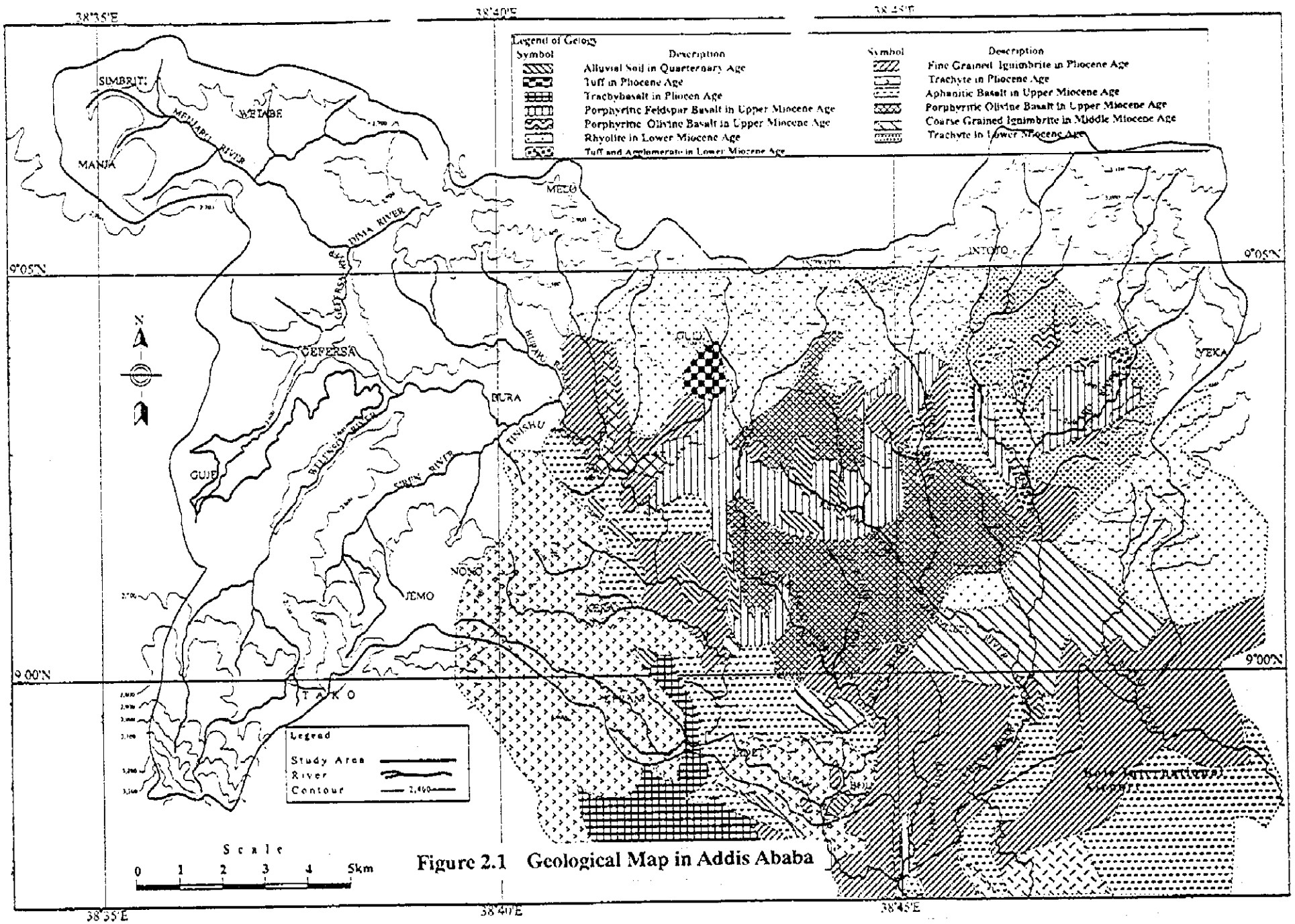


Figure 2.1 Geological Map in Addis Ababa

2.1.3 Vegetation

The land coverage of the Study area is characterized with the significant urban area of Addis Ababa, intensively or moderately cultivated area, woodland, and grassland. The upper basin of the Hanku river, in the most eastern part of the Study area is covered with mostly grassland up to the basin boundary. The middle basin is urbanized and the lower basin is again covered mainly with grassland.

The upper basins of the Little Akaki and the Kebena rivers in the northern part of the Study Area are still covered mainly with woodland. But certain portion of about 10 to 15% of the upper basin is an intensively or moderately cultivated land. The upper basin of the Kechene river is also covered mainly with woodland but the urbanization is already close to the basin boundary in the north.

The woodlands of these upper basins of the Kebena and their tributaries are composed of the trees of mainly eucalyptus. The area covered by the indigenous vegetation is only a few percent of the basin. The upper basin of the West Akaki river is located in the western and northwestern part of the Study Area and the land coverage is also woodland mainly consisting of eucalyptus.

2.1.4 Climate

The climate in the Study Area is subject to low pressure called as Inter Tropical Convergence Zone (ITCZ) moving across the equator seasonally northward and southward on the African Continent. The average annual rainfall in Addis Ababa amounts to 1,178 mm. The main wet season generally takes place from June to September, causing about 70% of annual rainfall. The highest peak of monthly rainfall occurs in August. Another small peak of monthly rainfall is observed in April. Seasonal variation of air temperature is less through a year. The average maximum temperature ranges from 24.3°C in May to 20.3°C in August, while the average minimum temperature varies from 11.8°C in May to 7.7°C in December. The climate in the Study Area is summarized in Table 2.1.

Table 2.1 Summary of Climate in the Study Area

Rainfall (mm)

JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	ANNUAL
17	39	68	95	76	122	254	278	174	37	8	11	1178

Temperature (Average Maximum, °C)

JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	ANNUAL
23.1	23.9	24.3	23.9	24.3	22.8	20.4	20.3	21.0	22.2	22.4	22.5	22.6

Temperature (Average Minimum, °C)

JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	ANNUAL
8.4	9.7	11.0	11.7	76	10.9	11.0	10.9	10.7	9.4	8.2	7.7	10.1

Source: National Meteorological Services Agency of Ethiopia (NMSA)

2.1.5 Hydrology

(1) River Systems

The Study Area is located in the uppermost catchment area of the Awash river basin. The rivers concerned with the Study Area can be classified into the five river systems, namely, West Akaki, Little Akaki, Kebena, Bantyiketu including tributaries of Kechene and Kurtume, and Hanku, as described in Table 2.2.

(2) Runoff

In the Study Area, daily gauge height and runoff records are only available on the West Akai river at Gefersa. The daily gauge height has been recorded since 1989. However, the gauge height has not been converted into runoff for the period of less than one year from the beginning. There is a gauging station on the Akaki river at Akaki with a catchment area of 884 km^2. This gauging station is located about 20 km downstream from the boundary of the Study Area. The average annual runoff at Akai is 8.8 m^3/sec.

Table 2.2 River Systems in the Study Area

River System	Description	Length (km)	Catchment Area (km^2)
West Akaki	Mainstream of the West Akaiki system with a catchment area covering more than half of the Study Area in the west.	32.1	172.2
Little Akaki	Major tributary joining the mainstream of the West Akaki river on the southern boundary of the Study Area.	20.5	30.8
Kebena	Major river covering about 30% of the Study Area in the east, and joining the mainstream of the East Akaki river about 8 km downstream from the southern boundary of the Study Area.	29.0	59.8
Bantyiketu	Bantyiketu River:	4.5	5.4
	Tributary joining the Kebena river about 1 km upstream of the Bole bridge.		
	Kechene River:	11.2	13.6
	Upper reaches of the Bantyiketu river before joining the Kurtume river at the Filwiha bridge.		
	Kurtume River:	9.3	10.3
	Tributary joining the Kechene river at the Filwiha bridge.		
Hanku	Tributary flowing down in the southeastern part of the Study Area and joining the East Akaki mainstream about 10 km downstream from the boundary of the Study Area.	8.6	11.1

Note: 1) Figures of river length and catchment area indicate those within the Study Area.
2) River length and catchment area of the Bantyiketu river give those between the Kebena confluence to the Kechene/Kurtume confluence. Catchment area of the Bantyiketu river system with the Kechene and Kurtume rivers is 29.3 km^2.
3) The Bantyiketu river is a tributary of the Kebena river. Total catchment area of the Kebena river system with the Bantyiketu river system is 89.1 km within the Study Area.

2.2 Socio-economy

2.2.1 Administration

(1) National Administration

Ethiopia has nine regions and two special municipalities. The nine regions are Tigray, Afar, Amhara, Oromia, Somali, Benishangul Gumuz, S.N.N.P.R. (Southern Nations Nationalities and People's Region), Gambela, Harari, and the two special municipalities are Addis Ababa and Dire Dawa. Addis Ababa is the capital city of Ethiopia. Approximate location of the regions and municipalities are shown in Figure 2.2.

Figure 2.3 shows administrative structure of the Federal Government of Ethiopia. Out of the ministries shown in Figure 2.3, ministries which are related to flood control project in Addis Ababa are the Ministry of Water Resources, the Ministry of Urban Development and Housing, and Ministry of Economic Development and Cooperation.

The Ministry of Water Resources is responsible for nationwide water resources development. The Hydrology Department of the Ministry has closely related to this project in view of water level observation in the Awash river and a flood forecasting system for the Koka lake which is under planning. Upon the request from the Region 14 Administration or other regions, the Ministry has responsibility to provide consultation in the field of water resources development.

The National Urban Planning Institute, one of the organization under the Ministry of Urban Development and Housing, is responsible for urban development in Addis Ababa through the Bureau of Works and Urban Development of the Region 14 Administration.

Ministry of Economic Development and Cooperation (MEDAC) is in charge of coordination of multilateral and bilateral development aid and loans in cooperation with the concerned organs and follow up their implementation, as one of its duties. Preparation and following up of long, medium, short-term development plans based on country's development strategy are also MEDAC's one of the major duties.

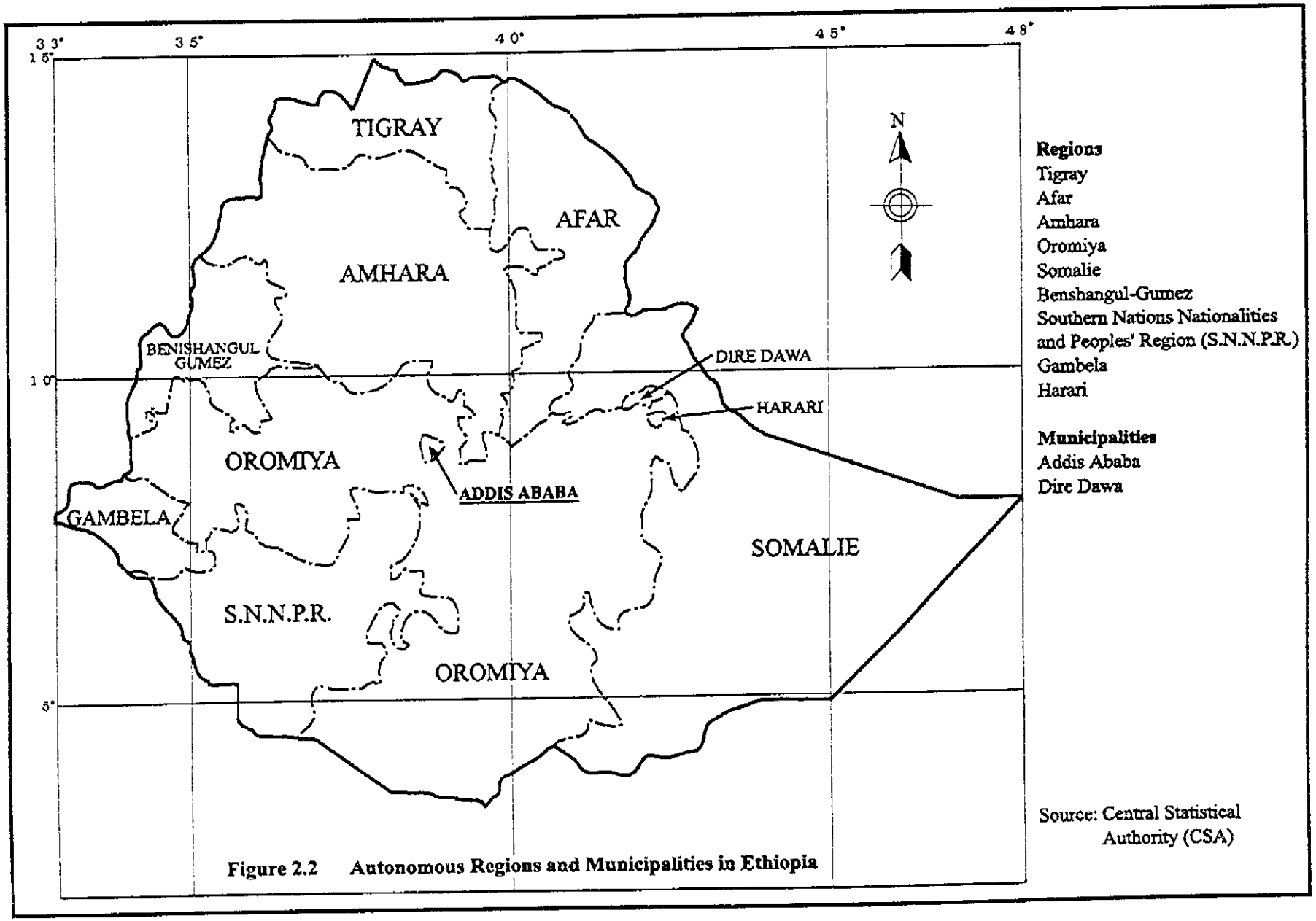


Figure 2.2 Autonomous Regions and Municipalities in Ethiopia

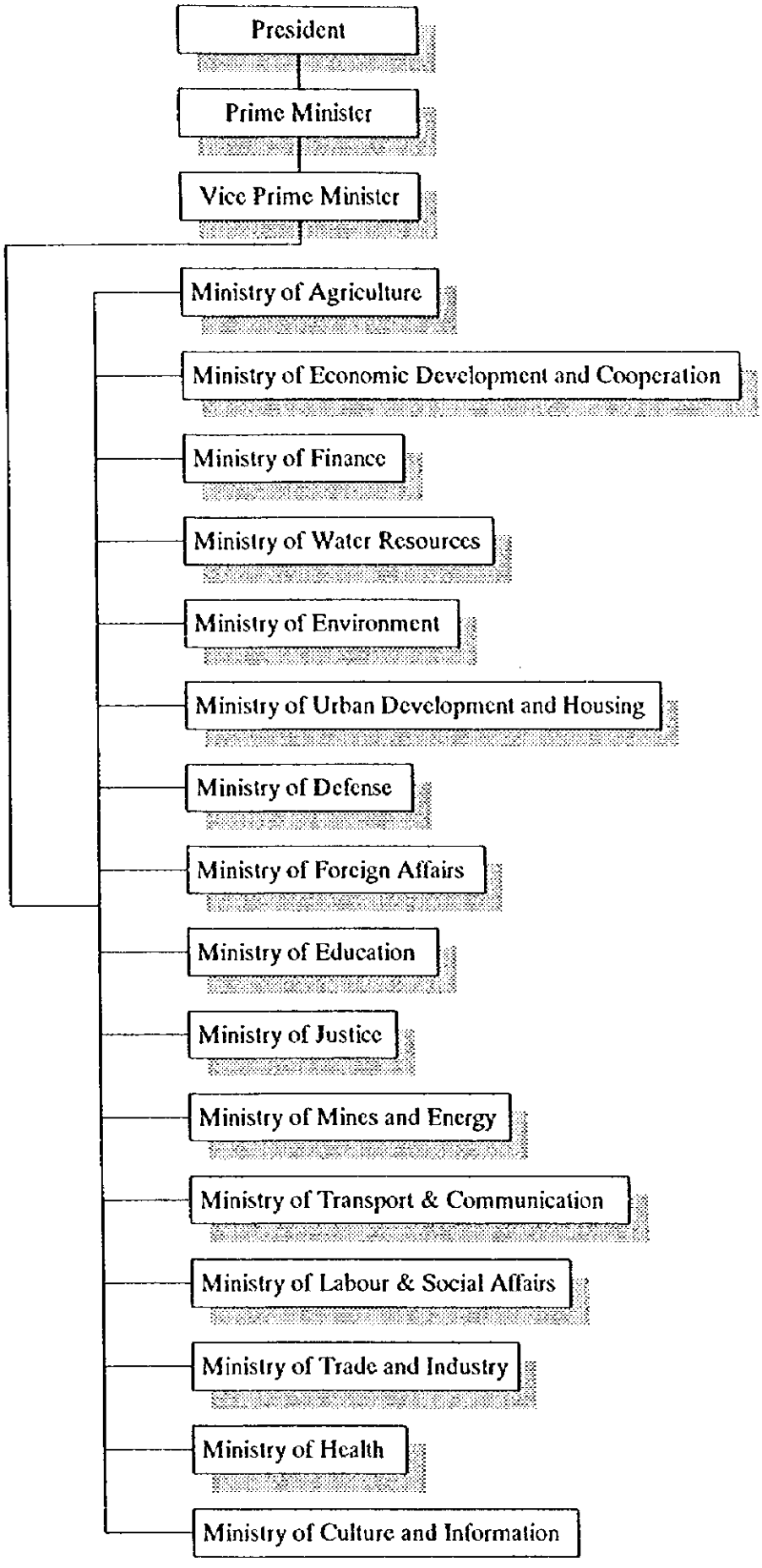


Figure 2.3 Administrative Structure of the Federal Government

(2) Region 14 Administration

The municipal government of the Region 14 Administration governs Addis Ababa, the capital city of Ethiopia. The municipal boundary of Addis Ababa is shown in Figure 2.4.

Addis Ababa has 6 zones. The 6 zones are further subdivided into 28 weredas, consisting of 305 kebeles and 23 farmers associations. Kebele is the smallest administrative unit in urban area with its own jurisdiction and is an association of urban dwellers formed by inhabitants. Out of 28 weredas, only 5 weredas have rural part where the farmers associations are situated. Farmers association is the smallest administrative unit in a settled rural area with its own jurisdiction and is an association of rural dwellers formed by inhabitants of a given area whose members are engaged either in agricultural and/or non-agricultural activities.

The organization chart of the Region 14 Administration is shown in Figure 2.5. The parliament headed by the President (Mayor), is organized by 15 members. The Executive Committee as a secretariat supports the parliament. Under directions by the Vice President, there are the Economic and Social Sectors. On the other hand, there are the Administration Sector, and zonal and wereda administrations which are directed by the secretariat. The Economic Sector in charge of flood control and prevention in Addis Ababa as one of its duties, is organized by 7 bureaus and 4 special offices as shown in Figure 2.6 and presented below.

a) Bureau

- Planning and Economic Development Bureau
- Trade Industry and Tourism Bureau
- Works and Urban Development Bureau
- Finance Bureau
- Agricultural Bureau
- Transport and Communication Bureau
- Environmental Management Bureau

b) Special Offices

- Environmental Development Office
- Addis Ababa Flood Control and Prevention Project Office
- Project Implementation Office
- Addis Ababa Water Supply and Sewerage Authority

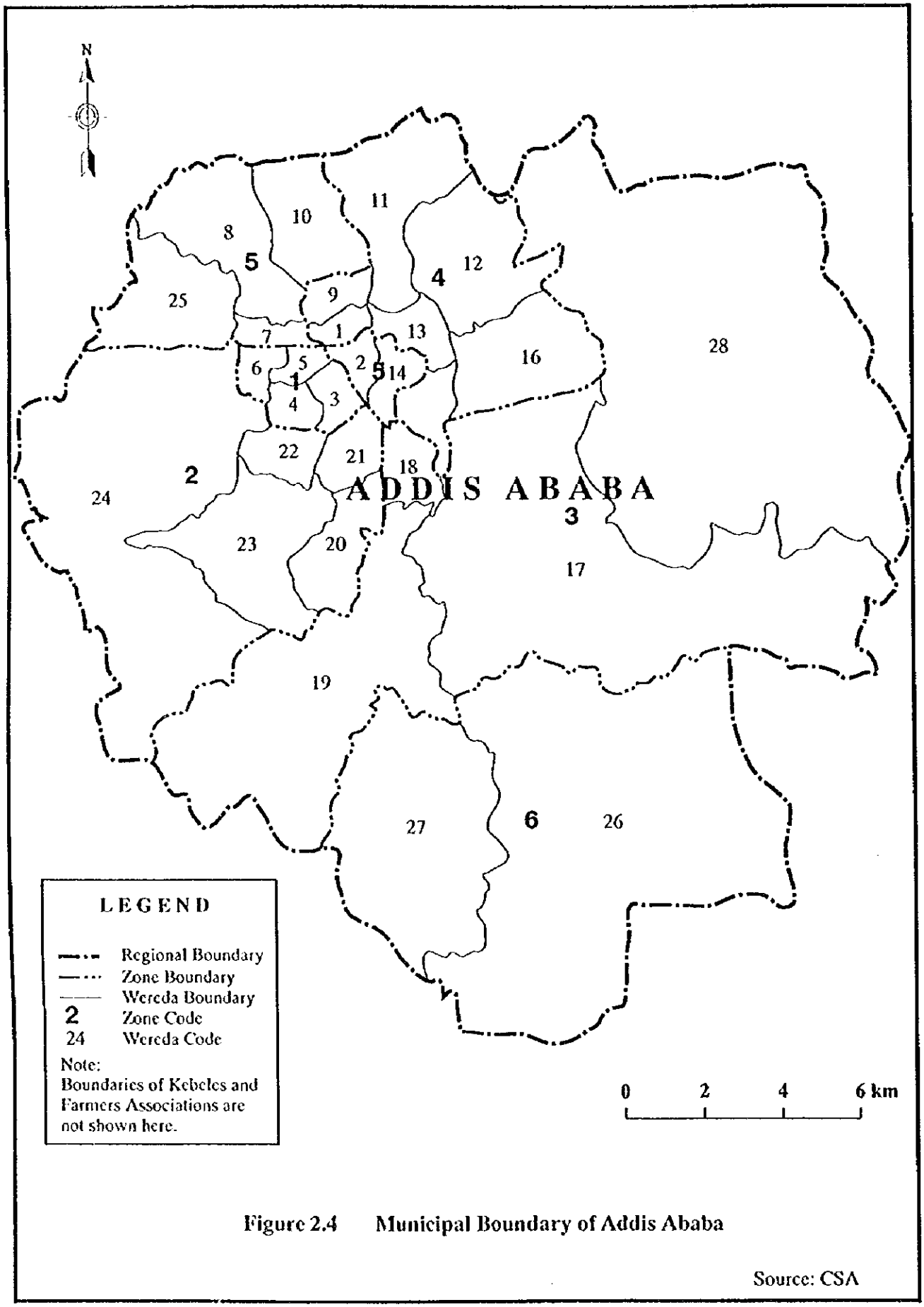


Figure 2.4 Municipal Boundary of Addis Ababa

Source: CSA

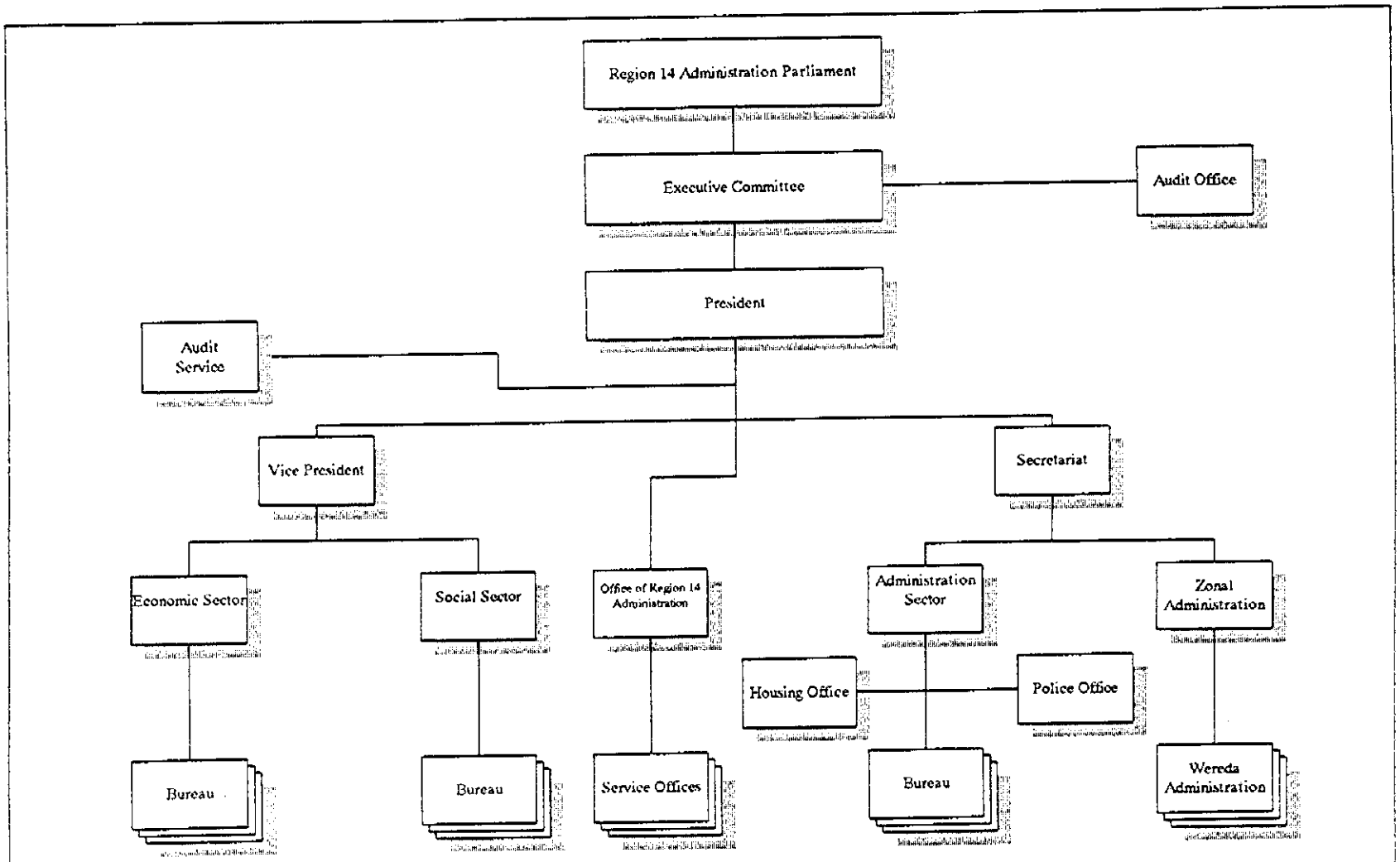


Figure 2.5 **Organization of Region 14 Administration**

Source : Region 14 Administration

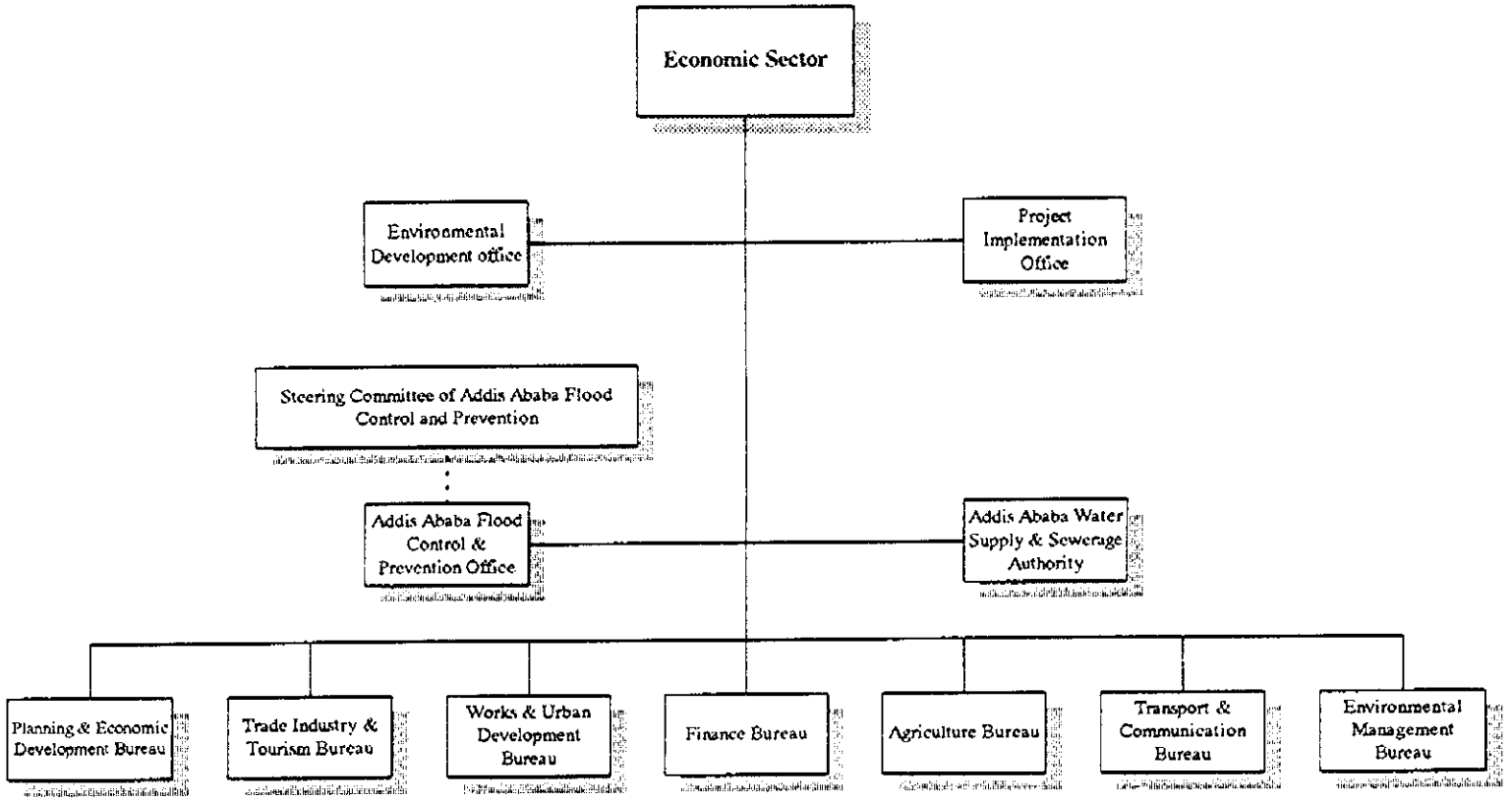


Figure 2.6 Organization of Economic Sector

Source : Region 14 Administration

2.2.2 National and Regional Development Plan

(1) National Development Plan

The Federal Government of Ethiopia set the Five Year Program on Development, Peace and Democracy (July 1995 – July 2000). The Ministry of Economic Development and Cooperation (MEDAC) had initiated the Program and it was approved by the parliament of Ethiopia. The program has three basic goals; ensuring accelerated and sustainable economic growth; guaranteeing peace and stability; and promoting the democratization process. The program aims average annual economic growth rate at 7 to 10%.

Consistently with the Five Year Program, Public Expenditure Program (PEP) and Public Investment Program (PIP) is being designed by the Government. PEP is a middle term program for recurrent expenditure program to be designed and followed up by the Ministry of Finance. PIP is also a middle term program for capital investment to be designed and followed up by MEDAC. Both programs will be formulated in several months.

(2) Regional Development Plan

1) Five Year Development Plan

Region 14 Administration is preparing the five year development plan (1997/98 - 2001/02) at present but it has not been officially authorized yet. According to the draft plan, it covers wide variety of aspects as listed below.

a) Economic Plan

- Improvement of the living standard
- Increment of the economic infrastructures
- Improvement of transport and communication services
- Improvement of agricultural economy
- Environmental protection
- Improvement of tourism
- Increase the government revenue

b) Social Plan

- Improvement of educational services
- Health services

- Environmental sanitation services
- Sports and cultural services
- Reduction of other social calamities

c) Political and administrative plan

- Democratic culture and development to be build by direct, wide and all round participation of the people.
- Strengthening of the peoples elective body structure by rendering it directly responsible to the people
- Expanding the judiciary organs to improve the judicial system
- Improvement of bureaucracy
- Development of the security forces efficiency

Out of the plans shown above, flood protection is also included as one of the major concern for development. The plan includes the following items:

a) To set a flood control master plan and a detailed plan for priority works,
b) To take necessary measures to reduce the lighter level of loss of life and property from flooding,
c) To identify flood prone areas and to complete the study for resettlement of the people, and
d) To take necessary measures including construction of flood walls in line with the flood control master plan.

2) Addis Ababa Master Plan

Master Plan of Addis Ababa was formulated by Region 14 Administration with technical cooperation by Italian Government in 1986. The Master Plan has been authorized by the Ministry of Urban Development and Housing (MUDH) - National Urban Planning Institute (NUPI) in 1994. The Master Plan takes up various topics such as population, agriculture, industry, transport, housing, town and landscape including social services and public utilities, and land use. The outline of the Master Plan is described below.

a) Outline of Addis Ababa Master Plan

The Master Plan set the target year in 2006 with a span of twenty years from 1986 to 2006. The population of the core area (present area of Addis Ababa) in the target year

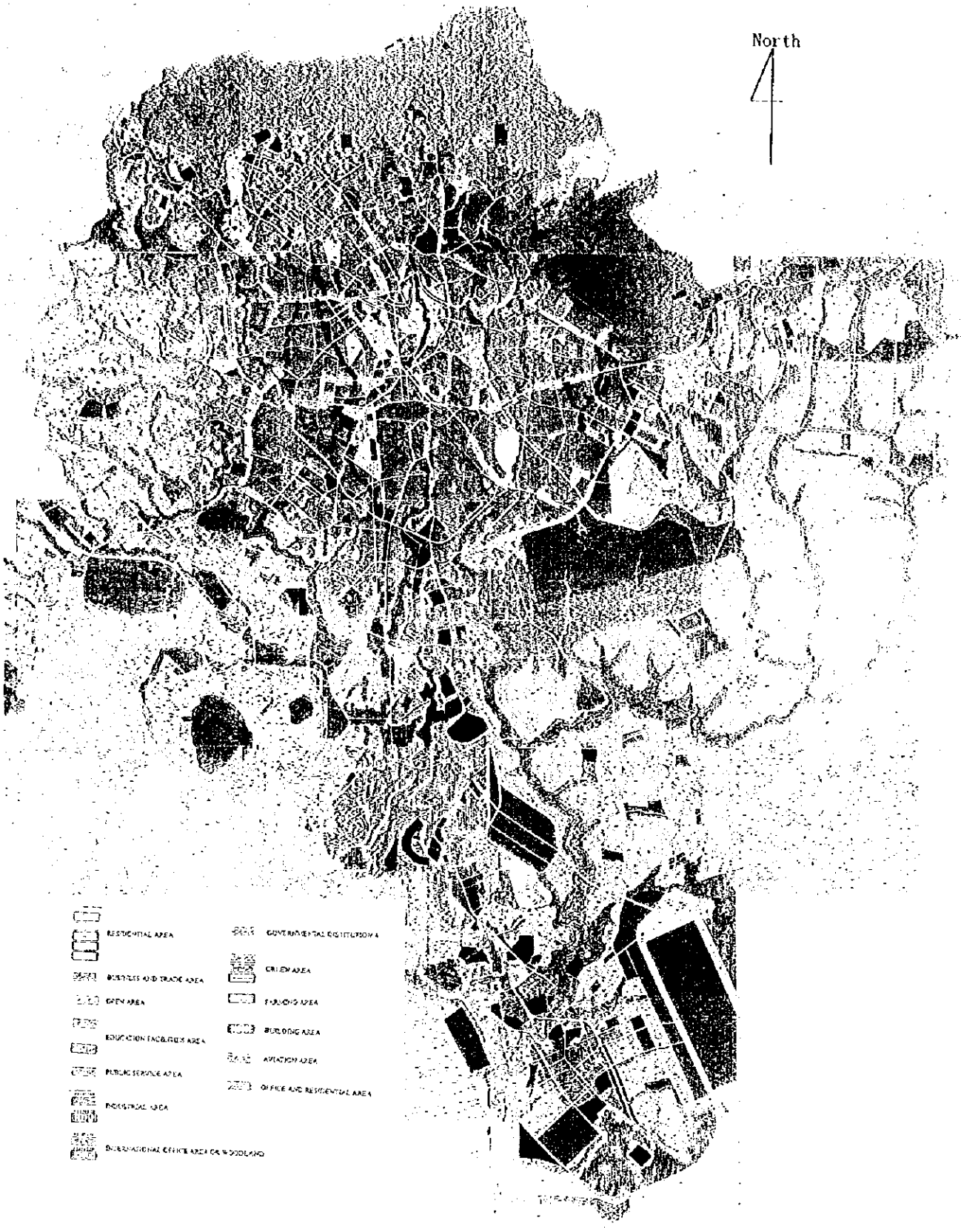
is projected to be 2.7 million from 1.6 million in 1986, while the population of whole planning region including Shoa and Aris areas is projected to 20 million from 11 million in 1986. The land use plan is prepared as shown in Figure 2.7. The Works and Urban Development Bureau (WUDB) of Region 14 Administration is assigned as a plan (project) implementation office. WUDB is responsible for design, evaluation, survey, registration land assignment, and supervision and control in line with the authorized master plan.

b) Present Status of the Master Plan

Currently, the Addis Ababa Master Plan is the governing document that guides and regulates the development of the city. Any development activity in the city, is checked against the proposal of the Master Plan before it enters into the process of implementation. The task of monitoring the implementation process of the Master Plan is shouldered by Master Plan Development and Inspection Department, which has been established within Works and Urban Development Bureau in 1994. This department is in charge of not only monitoring the implementation process, but also play the role of facilitating and promoting the implementation of the Master Plan.

In line with the objective of facilitating the implementation process, the Master Plan Department is expected to undertake various studies such as, detailed plan preparation for area development, demand - supplies analysis on social services, etc. In this respect the Department is currently in carrying out the following development studies:

- Preparation of development plan for extension area (an area of 240 ha, in Akaki area which is expected to accommodate some 4,000 residential houses),
- Preparation of plans for Inner City Redevelopment (an area of 50 ha, around National Theater). This project is expected to come up with detailed proposals regarding renewal of buildings, road and other infrastructure network within the project area,
- Preparation of Sub-center development plans (land-use plan, relocation and compensation, etc.),
- Preparation of Wereda Sub-center (land-use plan, relocation and compensation, etc.),
- Preparation of detailed plans for development of public parks (2 locations), and
- A study of identifying sites proposed for social services and assessing its present land use.



Source : Addis Ababa Master Plan,
National Urban Planning Institute

Figure 2.7 Land Use Plan by Addis Ababa Master Plan

2.2.3 Population

The latest (the second) nationwide population and housing census was conducted in October 1994. The 1994 Population and Housing Census of Ethiopia was conducted by Office of the Population and Housing Census Commission, Central Statistical Authority (CSA). In the latest Ethiopia Statistical Abstract 1995, the total population of Ethiopia was estimated at 54.9 million in 1994, while urban population was 8.2 million and rural population was 46.7 million. The total population increased by 12 million as compared with that in 1984.

Average annual growth rate of population in Addis Ababa indicates higher increasing trend than that in the whole Ethiopia. The population in Addis Ababa increased from 1.4 million in 1984 to 2.1 million in 1994 with an average annual growth rate of 3.5%. Addis Ababa expanded its area from 220 km^2 in 1984 to 510 km^2 in 1994. Out of 510 km^2, 250 km^2 is rural area. Population in Ethiopia and Addis Ababa is summarized in Table 2.3.

Table 2.3 Population in Ethiopia and Addis Ababa

	Population (1,000 persons)			Growth Rate	
	1978	1984	1994	1978-1984	1984-1994
Ethiopia					
Urban	3,720	4,869	8,219	4.6%	5.4%
Rural	25,689	37,747	46,720	6.6%	2.2%
Total	29,409	42,616	54,939	6.4%	2.6%
Addis Ababa					
Urban	1,168	1,423	2,085	3.3%	3.9%
Rural	-	-	28	-	-
Total	1,168	1,423	2,113	3.3%	4.0%

Source: 1. Ethiopia Statistical Abstract 1978, 1995, CSA
2. Population and Housing Census of Ethiopia, 1984, 1994, CSA
3. Report on the Analysis of the Addis Ababa Demographic Survey, 1978, Central Statistic Office

The economically active population is defined as persons aged 10 years and over, and who are working or looking for a job in Ethiopia. The economically active population in Addis Ababa increased almost double in a decade from 1984 to 1994 as shown in Table 2.4.

On the other hand, unemployment ratio of Addis Ababa increased from 10.5% in 1984 to 34.7% in 1994. It shows that increase of job opportunities has not catch up with rapid population growth partly due to influx of population from rural areas.

Table 2.4 Population of 10 Years and Over, Economically Active Population in Addis Ababa

	Population of 10 Years and Over	Economically Active Population	Working Population	Ratio of Economically Active Population	Unemployment Ratio
Year 1984					
Urban	1,034,308	470,308	421,027	45.5%	10.5%
Rural	-	-	-	-	
Total	1,034,308	470,308	421,027	45.5%	10.5%
Year 1994					
Urban	1,690,944	890,015	577,272	52.6%	35.1%
Rural	20,055	13,461	12,387	67.1%	8.0%
Total	1,710,999	903,476	589,659	52.8%	34.7%

Source: Population and Housing Census of Ethiopia, 1984, 1994, CSA

2.2.4 Economic Conditions

(1) Gross Domestic Products

The Federal Government of Ethiopia set a target of an average annual economic growth rate of 7% to 10% in its Five Year Program (July 1995 – June 2000). Gross Domestic Product (GDP) in 1994/95 has been estimated at 34,063 million Birr (approximately US$5 billion) by MEDAC and GDP per capita in 1994/95 could be estimated at 609 Birr (approximately US$90). Average annual growth rate of GDP during 10 years from 1984/85 to 1994/95 was 3.8% on 1980/81 constant factor cost basis. However, average annual growth rate of GDP per capita was only 0.5% on the same basis. This shows that the economic growth has not caught up with the rapid population growth. Figure 2.8 shows GDP of Ethiopia from the year 1980/81 to 1994/95.

Gross Regional Domestic Product (GRDP) of Addis Ababa has not been estimated yet. The Region 14 Administration organized a working team for estimation of GRDP and the team has been working since one year ago. Results of the working team will be compiled in several months.

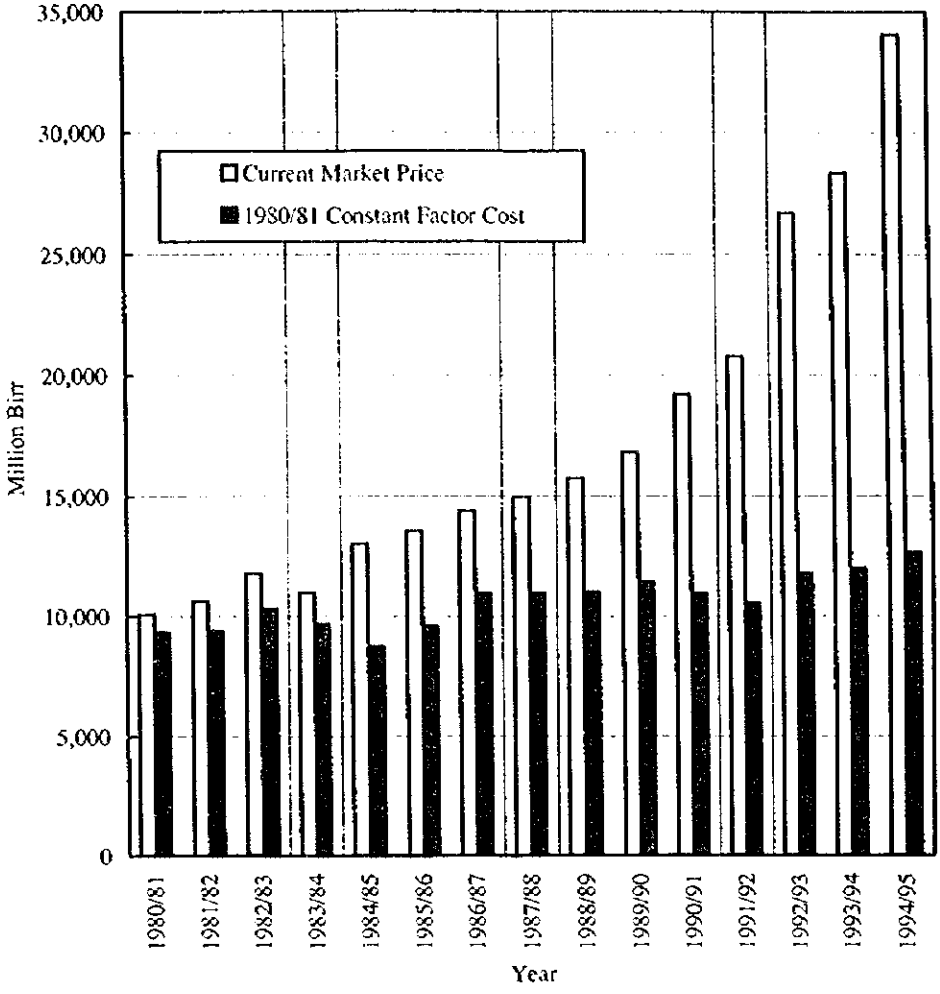


Figure 2.8 Gross Domestic Product

Source : National Account of Ethiopia, Revised Series, 1980/81-1994/95, MEDAC

(2) Agriculture

In the Five Year Program (1995-2000), it says that agriculture is the main stay of the Ethiopian economy from which about 85% of the population earns its livelihood. In the peripheral areas of Addis Ababa, there are 25 Peasant Associations with a total population of about 28,200 practicing mixed farming. The total land coverage of the Peasant Association is estimated to be 17,000 hectares, of which 65% and 17% of areas are allocated to farms and pasture lands respectively. The livestock population of the Peasant Association comprises of about 25,900 heads of cattle, 6,500 sheep and goats, and 5,100 private and 5,100 draught animals.

(3) Manufacturing Industry

The Federal Government of Ethiopia aims industrialization lead by agricultural development (ADLI). Supply of raw materials for the manufacturing sector will be improved by productivity growth of the agricultural sector.

According to Ethiopia Statistical Abstract on production of major manufacturing articles from 1989/90 to 1993/94 in Ethiopia, sugar production kept large volume at 123,300 tons in 1993/94. Production of cotton fabrics and semi-processed skins has also been increasing remarkably. As construction materials, cement, cement blocks and tubes, and iron bars are also increasing their production year by year.

(3) Import and Export

According to "Economic Research and Planning Department of National Bank of Ethiopia" on main export and import commodities of Ethiopia, exports of coffee accounted for 62% in 1996/97. Other major commodities are leather and leather products and gold, accounted for 8.8% and 11.4%, respectively in the same year.

Coffee is Ethiopia's important commodity. According to Ethiopia Statistical Abstract, production volume of coffee has fluctuated between 60,000 ton and 110,000 ton by year according to climate. Export volume of coffee has also fluctuated between 45,000 ton and 102,000 ton depending on the production.

(4) International Balance of Payment

According to the Economic Research and Planning Department of National Bank of Ethiopia, basic balances including the trade balance, services balance, transfer, and long-term capital account in 1995/96 and 1996/97, were deficit of US$142.3 million and US$357.5 million respectively due to imbalance of import and export. Overall balances which further include the short-term capital account and private capital account in 1995/96 and 1996/97 were deficit of US$40.4 million and US$ 354.6 million respectively.

Table 2.5 International Balance of Payment

(Unit: Million Birr)

Items	Fiscal Year				
	1992/93	1993/94	1994/95	1995/96	1996/97
Current Account	-204.2	-92.2	190.1	-202.5	-188.0
Long-term Capital Account	3.2	189.4	12.4	60.2	-169.5
Basic Balance	-201.0	97.2	202.5	-142.3	-357.5
Short-term + Private Capital Account	-131.1	46.9	-3.8	-71.5	45.2
Errors and Omissions	233.5	23.6	-49.7	175.3	-42.3
Overall Balance	-98.8	167.7	148.9	-40.4	-354.6

Note: Figures in 1995/96 and 1996/97 are preliminary estimate.
Source: Economic Research and Planing Department, National Bank of Ethiopia

(5) Prices

According to the Ethiopia Statistical Abstract, movement of the retail price in Addis Ababa continued with its upward trend. Average annual increasing ratio during 10 years from 1986 to 1996 was high at 7.5% in general item but it slowed down to 3.9% during 4 years from 1992 to 1996.

(6) Foreign Currency Exchange Rate

A fixed foreign exchange rate at 2.07 Birr equivalent to US$1 had been applied until October 1992. After that it was devaluated to 5.00 Birr equivalent to US$1 and this fixed rate had been applied until June 1993. Since June 28, 1993, the foreign exchange rates have been decided by the weekly foreign exchange auction that takes place in Addis Ababa.

Table 2.6 shows foreign exchange rate between US dollar, Japanese Yen and Ethiopian Birr currencies since January 1993. The rates are middle rates at the end of each month. The exchange rate of 5.10 Birr to US$1.00 in June 1993 was gradually depreciated to 6.80 Birr to US$1.00 in July 1997.

Table 2.6 Foreign Exchange Rate

(Unit: Birr)

Year	1993	1994	1995	1996	1997
US Dollar	5.27	6.16	6.28	6.36	6.66
Japanese Yen	0.0477	0.0609	0.0661	0.0584	0.0554

Note: Average rate of middle rate at the end of each month.
Source: National Bank of Ethiopia