United Nations Educational, Scientific, and Cultural Organization

World Water Assessment Program

National Water Development Report for Ethiopia (Final)

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Ministry of Water Resources *P.O.Box 5673, Addis Ababa, Ethiopia*	United Nations Educational, Scientific and Cultural Organization	World Water Assessment Programme	*Generations Integrated Rural Development Consultants*

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ACRONYMS

% ..... Per cent
A.A ..... Addis Ababa
AAU..... Addis Ababa University
AAWSA..... Addis Ababa Water and Sewerage Authority
ADB..... African Development Bank
ADF..... African Development Fund
AFD..... Agence France Development
AMU ..... Arba Minch University
ARBA ..... Abay River Basin Authority
ARI ..... Acute Respiratory Infection
AU ..... Alemaya University
AWTI ..... Arba Minch Water Technology Institute
BCM ..... Billion Cubic Meters
BOD ..... Bio-chemical Oxygen Demand
BOWR..... Bureau of Water Resources
COD ..... Chemical Oxygen Demand
CSA..... Central Statistics Authority
CSE..... Conservation Strategy of Ethiopia
DCY ..... Discounted Life Year
DD..... Dissolved Solid
DDT..... DichloroDiphenylTrichloroethane
DO..... Dissolved Oxygen
DPT..... Death per Thousand
E.C ..... Ethiopian Calendar
EARO..... Ethiopian Agricultural Research Organization
EEPA ..... Ethiopian Electric Power Agency
EEPCO ..... Ethiopian Electric Power Corporation
EFAP ..... Ethiopian Forest Action Program
EIA ..... Environmental Impact Assessment
ELRC ..... Ethiopian Language Research Center
ENSO..... El Nino Southern Oscillation
EPA..... Environmental Protection Agency
EPRDF..... Ethiopian Peoples Revolutionary Democratic Front
ESA..... External Support Agencies
ESDP ..... Education Sector Development Programme

ESTC ..... Ethiopian Science and Technology Commission
ETC..... Ethiopian Telecommunication Corporation
ETP ..... Education Training Policy
EU ..... European Union
EVDSA..... Ethiopian Valleys Development Studies Authority
EWRMP ..... Ethiopian Water Resources Management Policy
EWRRC ..... Ethiopian Water Resources Research Centre
EWRRDC .. Ethiopian Water Resources Research Development Centre
EWWE ..... Ethiopian Water Works Construction Enterprise
FDRE ..... Federal Democratic Republic of Ethiopia
FPA..... Forest Priority Area
G.O.T. ..... Gambella, Oromiya and Tigray
GER ..... Gross Enrollment Rate
GIS..... Geographic Information System
GoE..... Government of Ethiopia
GWI..... Governing Water Indicator
HA ..... Hectare
HDP ..... Hydropower Development Programme
IBA ..... Important Bird Area
ICBP..... Institution and Capacity Building Programme
IDP ..... Irrigation Development Programme
IER ..... Institute of Education Research
IFAD..... International Fund for Agricultural Development
IPB ..... Institute of Patho- Biology
ITCZ..... Inter Tropical Convergence Zone
IUCN ..... International Union for Conservation of Nature and natural resources
IWRM..... Integrated Water Resources Management
JICA ..... Japan International Cooperation Agency
KWH ..... Kilo watt-hour
LAN..... Local Area Network
LRG..... Local Research Grant
M&E ..... Monitoring and Evaluation
MEDaC ..... Ministry of Economic Development and Cooperation
MOFED..... Ministry of Finance and Economic Development
MoH ..... Ministry of Health
MoI ..... Ministry of Industries
MoWR..... Ministry of Water Resources

MW..... Mega Watt
NBI ..... Nile Basin Initiative
NGOs..... None Governmental Organizations
NO3..... Nitrate
NTU..... Nephlometric Turbidity Unit
NWRC..... National Water Resources Commission
PO4..... Phosphate
PRSP ..... Poverty Reduction Strategy Programme
R&D ..... Research and Development
RWB ..... Regional Water Bureau
RWS ..... Rural Water Supply
RWSS..... Rural Water Supply and Sanitation
SAREC ..... Swedish Agency for Research Cooperation
SDPRP ..... Sustainable Development and Poverty Reduction Programme
SIDA..... Swedish International Development Agency
SNNPRS.... Southern Nations, Nationalities and Peoples Regional State
SS ..... Suspended Solid
TDS..... Total Dissolved Solids
TV ..... Tele vision
TVET..... Technical Vocational Education Training
UFW..... Unaccounted for Water
UNDP..... United Nations Development Programme
UNECA ..... United Nations Economic Commission for Africa
UNICF..... United Nations Children's Fund
US$..... United States Dollar
USD ..... United States Dollar
UWS ..... Urban Water Supply
VW ..... Valuing Water
WA ..... Water Allocation
WAN ..... Wide Area Network
WAPCOS .. Water and Power Consultancy
WatSan..... Water Supply and Sanitation
WB ..... World Bank
WC..... Water Committee
WCMC ..... World Conservation and Monitoring Centre
WHO..... World Health Organization
WMO..... World Meteorological Organization

WP ..... Water Policy
WRC ..... Water Resources Council
WRDF ..... Water Resource Development Fund
WSDP ..... Water Sector Development Program
WSDS ..... Water Sector Development Strategy
WSS..... Water Supply and Sanitation
WSS..... Water Supply Service
WSSA ..... Water Supply and Sewerage Authority
WSSDP ..... Water Supply and Sanitation Development Program
WWAP ..... World Water Assessment Program
WWDE..... Water Well Drilling Enterprise
WWDR..... World Water Development Report
WWDSE .... Water Works Design and Supervision Enterprise

Chapter 1

1. Background

1.1 General Context

The World Water Assessment Program was initiated in 2000 as a global mechanism for measuring and reporting Progress with achievement of international objectives in the water sector as part of the international sustainable development agenda, formalized in 1992, and re-evaluated and focused on developing countries in 2002 in Johannesburg. The first World Water Development Report was produced in 2003 and released at the 3rd World Water Forum in Kyoto.

The World Water Development Report is a triennial report, which is designed to give an authoritative picture of freshwater resources (through periodic review and continuous updating) and our stewardship of them. The WWDR builds upon Past assessments and will constitute a continuous series of assessments in the future. The report gives a broad and global picture and additional information from seven pilot case studies from seven Countries was also included.

The next WWDR is scheduled to be released at the next World Water Forum Conference in Mexico in 2006. As in the previous report, case studies from selected countries will be included. To work towards the WWDR, five African countries namely Kenya, Ethiopia, Uganda, Mali, and South Africa, among others, were brought on board to produce their respective National Water Development Report.

The necessary financé for preparing of the national reports was secured from DFID through WWAP. UNESCO and Ministry of Water Resources jointly coordinated the National Report Preparation in Ethiopia and Generations Integrated Rural Development Consultant prepared the Report through stakeholder consultation.

The report was prepared based on the outline agreed on the stakeholder consultation workshop held on September 4, 2004. In addition a National Task Force was established to advise the consultant in the preparation process through review of interim in reports and provision of necessarily data and information. Furthermore the draft report was reviewed by stakeholders on November 19 & 20,2004.

With in the time allowed for preparing the report, every effort has been made to get hold of existing available data of the sector. Latest information has been used in all sectors as much as resource allowed. The report gives information on the existing situation, as such it should not be considered as a technical study report where new data and information is generated.

Indicators for monitoring different aspects of the sector have been proposed. The use of these indicators by the sector in the future should give due consideration to the capacity of the involved institutions at the lowest level of Government structure.

The Report is comprised of 13 chapters dealing with different thematic issues. Data and information for each thematic Chapter is collected to the extent possible and documented.

1.1.1 Government Structure and Location of the Country

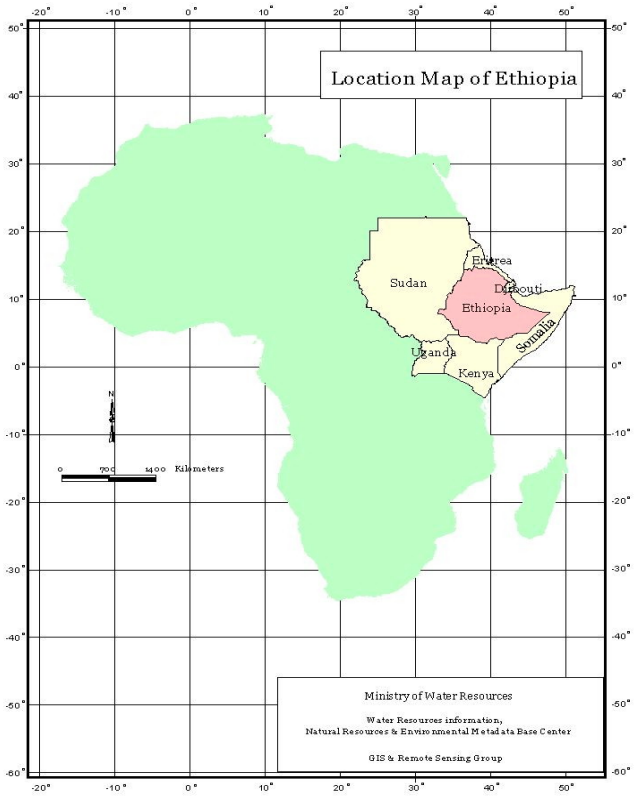
Ethiopia is an ancient country with rich diversity of peoples and cultures and a unique alphabet that has existed for more than 3000 years. The country has always maintained its independence, even during the colonial era in Africa.

Since 1991 Ethiopia has a federal administrative structure, which constitutes the federal and regional government. The source of power in all cases is the people of their respected constituency. The country has got nine regional governments, (Tigray, Afar, Amhara, Oromya, Somalia, Benshangul-Gumuz, Southern Nations Nationalities and Peoples, Gambella, Harari) and two city states (Addis Ababa, Dire Dawa). The National Regional States as well as the two cities administrative councils are further divided into five hundred eighty Woredas and to around 15,000 Kebels (5000 urban and 10,000 rural). The parliament is the highest legislative body and the prime minister office with his cabinet is higher executive body in the country. The federal government is mainly responsible for foreign issues, defence, fiscal matters, interregional & international rivers and other macro level policies. The council of federation is constitutionally mandated to look after regional equity issues and other interregional disputes.

Ethiopia is situated in the Horn of Africa. In the north and west the country is bordered by Sudan, in the South with Kenya, in the east with Somalia and Djibouti. In size, Ethiopia has an area of about one million square kilometres and stretches from latitude 3° North of the equator to latitude 15° North of the equator and from 33° East to 48° East longitudes.

Ethiopia's physical structure ties it to the landscape of the eastern half of the continent through the Great Rift Valley system, which stretches along the Red Sea, through Ethiopia and then South wards.

Fig 1.1: Location Map of Ethiopia



1.2 Major Characteristics

1.2.1 Topography, Geology, and Surface Area

Topographically, Ethiopia is divided in to a huge central plateau land surrounded by lowland plains. The Ethiopian plateau is an upheld block limited on the east by the Rift System and declining on the west to the Sudan plain. The eastern margin of the plateau is elevated to between 3000m and 4000m while, towards the west, the plateau surface descends to between 1200m and 1000m. The western highlands are massive with an average height of 2000-2500m. These high lands include many subdivisions separated by the deep, steep sided valleys of the major rivers.

Gorges are found along the upper courses of the big rivers, which flow, in deep canyons but widen out to broad and shallow valleys in their lower courses.

The general area of the central lava highlands and the northern central massifs has rugged surfaces with high elevation.

The south eastern highlands includes the highlands of Sidamo, Bale, Arsi, and Harerge. These highland regions are made up of volcanic rocks, but where the rivers cut deep, crystalline rocks are exposed. Rivers separate the areas of the higher land. The Afar Hills are limited in area and altitude but form a different region because they are at a higher altitude than the adjacent Afar lowlands. The Afar hills have steep sides and deep Valleys and some volcanic peaks rise to an elevation of about 2500 meters.

The main Ethiopian Rift extends for 500km from 9° 30'N to 4° 45'N. The Rift floor varies in elevation from1000m. The northern segment of the main Rift is 70-to80 km wide and the southern segment of the main Rift consists of the Abaya-Chamo Rift.

The lower Rift Valley is generally of low altitude (300-700meters) being mainly large plains and low tableland, which falls to about 110 meters below sea level. Active volcanoes are numerous and some lakes become salt flats.

The Outer lowlands are to the west of the Western highlands, and the east and south of the south eastern highlands which have inselberg topography, isolated hills scattered over the well developed plains. The Baro-Akobo basin forms flat lowland and extensive swamps and marshes.

1.2.2 Climate

1.2.2.1 Observed Climatic Variation

Latitude, altitude, winds and humidity with varying magnitude have significant impact on temperature conditions in Ethiopia. Although there are considerable differences between Highland Ethiopia and Lowland Ethiopia in the average monthly and annual temperatures, they are more or less similar in their small annuals range and large daily range of temperatures.

Ethiopia lies within the tropics, a zone of maximum insolation where every place has overhead sun twice a year. However, 43% of the country's cover consists of the highlands, and tropical temperature conditions are not experienced everywhere except the lowlands.

In Ethiopia temperature is greatly influenced by changing altitude. Lateral variation of relatively few kilometres may result in vertical changes of 1000 meters or more in some of the major canyons, on the slopes of high mountains and along the rift valley escarpments.

Extremes in temperatures range from the mean annual temperature of 34.5°c in the Danakil depression at 180 below mean sea level (msl) to mountain slopes of over 4000m above msl where minimum temperatures fall below zero.

As the sun is always high in tropics, seasonal variation is not as distinctly observable as the temperate zone of Northern Hemisphere. However, there is a slight temperature increase in summer. In most places of the country the highest temperatures are experienced between March and September, as this is the high sun period. As the relative position of the sun shifts, Southern Ethiopia has its highest temperature in autumn and spring when the sun is vertically overhead.

In summer the northern part of the country has the vertical sun and has its highest temperature at this time. Summer being the big rainy season, temperature is reduced considerably in the southern and southwestern parts where humidity is high and cloud cover frequent.

In Ethiopia the major factors influencing rainfall are the inter-tropical convergence zone (ITCZ) the northern trade winds, and southern monsoon. Even though climate conditions are classified into generalized areas of specific types of climate, there are significant micro-climatic variations over relatively small areas due to micro-relief variations. Altitude is the single most important factor influencing the climatic condition of the country. The main climatic regions of Ethiopia are: Dry climate, tropical rainy climate, and temperate rainy climate.

1.2.2.2 The Hydrological Influence of Climatic Change

Climate is the function of the location (latitude), altitude, angle of the sun, distance from oceans or other water bodies, terrain and the like. The different combination of these factors resulted in the prevalence of diverse climatic conditions in Ethiopia. The major climatic conditions in Ethiopia can be categorized as tropical in the south and southwest, climatic in the highlands and arid and semi-arid in the Northeastern and Southeastern lowlands.

Ethiopia's hydrology is a direct reflection of the climate, the terrain and other physical characteristics. The very high variability exhibited by the climate components of the country over time and space is the main reason behind the spatial and temporal variability in the availability of water. The following table shows the spatial variation of surface runoff with other climatic variables for the river basins of the country. It can be concluded that the wetter southwest and western part of the country produces most of the runoff where as the southeast, east, and north comparatively produces very less surface runoff.

Table 1.1: Climate Variation in the River Basins

No.	Basin Name	Location	Temperature (^{0}C)		Average Rainfall (mm)	Average Evaporation (mm)	Surface Runoff (BM^3)
			Min	Max			
1	Wabishebele	4045'N-9045'N 38045' E-45045'E	6	27	425	1500	3.4
2	Abbay (Blue Nile)	7045'N-12045'N 34005' E-39005'E	11.4	25.5	1420	1300	54.4
3	Genale Dawa	3030'N-7020'N 37005' E-43020'E	<15	>25	528	1450	6.0
4	Awash	8030'N-12000'N 38005' E-43025'E	20.8	29	557	1800	4.9
5	Tekeze	11040'N-15012'N 36030' E-39050'E	<10	>22	1300	1400	8.2
6	Danakil	1200'N-1500'N 3900' E-4200'E	5.7	57.3	Na	Na	0.86
7	Ogaden	5030'N-9044'N 42041' E-45000' E	25	39	400	Na	0
8	Omo –Ghibe	4030'N-9030'N 35041' E-3800' E	17	29	1140	1600	16.6
9	Baro-Akobo	5031'N-10054'N 3300' E-36017' E	<17	>28	1419	1800	23.23
10	Rift Valley Lakes	4020'N-8030'N 36030' E-39030' E	<10	>27	Na	1607	5.64
11	Mereb	14003'N-14052'N 37051' E-39027' E	18	27	Na	1500	0.72
12	Aysha	10000'N-11000'N 42000' E-43000' E	26	40	Na	na	0

Source: Fekahmed ,2004

1.2.3 Land Use

Three main factors appear to have influenced both the use of the land and the natural vegetation cover type as they are presently expressed in Ethiopia.

The influence of climate is manifested by the response in land using activities to its rainfall and temperature parameters and their various implications.

Rain fed crop cultivation is the principal activity in most of the area where adequate rainfall is available. In semi-arid to arid conditions, pastoral livestock raising becomes predominant. Response to the temperature factor is also manifested in several ways; predominance of sorghum and cotton, for example in warmer areas, and that of barley in cooler areas; or prevalence of horses as "beasts of burden" in the cooler areas and that of donkeys and camels in the warmer areas.

The climate of Ethiopia ranges from the hot desert type in the Danakil to the cool temperate type in the highlands, affecting the concomitant variations in land using activities.

Slope and stoniness are the two parameters of the terrain to which land use activities show response. Precipitous slopes are generally still under natural vegetation cover, while the rolling plateau and terraces are intensively used for cropping and/or grazing.

Population, in both its distribution and size, as well as in its cultural orientation and practices, has had a tremendous impact on the cover type of the country. Large areas in the north of the country with high population densities are completely devoid of vegetative cover outside of the cropping period. Some areas have no soil cover left due to previous agricultural mismanagement, which resulted in total erosion of the soil cover and exposure of extensive areas of the bedrock. The southwestern and southwestern parts of the country have not experienced comparable population pressures and therefore have large areas of natural cover types intact.

About 10% of Ethiopia is intensively cultivated land. Hardly any tree vegetation is visible, virtually all the land being opened up for cropping (largely grains, legumes and oil seeds) and/or grazing of livestock. Grazing land tends to be over-stocked and vegetative cover is rarely more than a few centimetres high even at the peak of the rainy season. Crop residues are also grazed. Thus there are extensive areas of bore soil by the end of the dry season at the onset of the following rains. Tremendous erosion ensues, more so of course when population pressure has forced system up onto steeper slopes. Where the cycle has been practiced for hundreds of years-as in northern Shewa, Welo, Tigray and Gonder-land is severely degraded. Terracing is increasing in such areas, but much land may be beyond repair.

Moderately cultivated land makes up another 11% of Ethiopia. Although the farming systems are comparable, the presence of some natural vegetation and more extensive grazing lands somewhat reduces pressure on the land. Erosion, while severe, is ongoing. With population pressure, these moderately cultivated lands, which are generally distributed around the intensively cultivated lands, are becoming more intensively used.

Significant areas in northern Sidamo, Southern Welega and Shewa, kefa, Gamo Gofa, Ilubabor and the Chercher highlands are under perennial crop cultivation with little land under annual crops. These areas are approximately 1.6% of the country. Occasionally however cropping of perennials is combined with extremely intensive associated land use, as for example in the areas of Ensue cultivation where grazing lands are severely degraded due to very high livestock densities, or for example in the areas of chat and coffee cultivation in the Chercher highlands where sorghum is intensively cultivated on steep slopes.

Approximately 0.2% of Ethiopia has been developed as State Farms.

Dense coniferous and dense mixed high forests have been removed over most of their extent in Ethiopia, and cove now only 2.3% of the country. Afurther2% is under disturbed high forest that is high forest that is currently being cleared for human settlement. Only

remnants of coniferous forest are still found, of podocarpus in the southwest and of Junipers in central Sidamo and the character highlands. Most of the mixed high forest is in the southwest, where rainfall is above 1 500 mm.

Woodland, bush land, scrubland and grassland, with varying densities of tree, bush, shrub and grass cover make up approximately 55% of Ethiopia. In the parts of the country with higher precipitation, such areas are generally given over to peasant livestock grazing with scattered crop cultivation, in drier parts of the country, pastoral livestock grazing predominated.

Approximately .80% of Ethiopia is perennial and seasonal swamp and marsh and 16% bare land. These lands are generally not economically productive, with the occasional exception of some nomadic or peasant livestock grazing, and such activities as for example, mining of salt flats in the Danakil.

1.2.4 Major Socio-Economic Characteristics

1.2.4.1 Demography

Population size

The primary source of information for data on population numbers and distribution is the Central Statistical Authority (CSA) of the country. The most recent countrywide population census was conducted in 1994, ten years ago with additional censuses in Affar and Somali Regions in 1996 and 1997 respectively. The Authority publishes regular abstracts, the latest one in January 2003 containing estimates of population numbers in July 2004.

CSA estimates for January-2004 population of the country at 71.06 million. Of this 59.9 million is classified as rural and 11.2 million as urban population. Table 1.2 shows the breakdown per regional state.

Table 1.2: Population Estimate, year 2003

No	Region	Population			Percentage	Percentages	
		Total	Rural	Urban	of Nation	Rural	Urban
1	Tigray	4,113,000	3,367,000	746,000	5.8	82	18
2	Affar	1,330,000	1,213,000	117,000	1.9	91	9
3	Amhara	18,143,000	16,138,000	2,005,000	25.5	89	11
4	Oromiya	25,098,000	21,891,000	3,207,000	35.3	87	13
5	Somali	4,109,000	3,438,000	671,000	5.8	84	16
6	Benishangul	594,000	538,000	56,000	0.8	91	9
7	SNNPR	14,085,000	12,922,000	1,163,000	19.8	92	8
8	Gambela	234,000	191,000	43,000	0.3	82	18
9	Harari	185,000	71,000	114,000	0.3	38	62
10	Addis Ababa	2,805,000	0	2,805,000	3.9	0	100
11	Dire Dawa	370,000	98,000	272,000	0.5	26	74
Total Country		71,066,000	59,867,000	11,199,000	100	84	16

Source: CSA Statistical Abstract 2003

Practically 81 percent of the country's population lives in the three regions of Oromiya, Amhara and SNNP, representing 35 percent, 26 percent and 20 percent of the total population, respectively. The SNNP has the highest population density (about 120 people /Km2), with Amhara having the second highest population density (118 people / Km2). The

Gambella Region has the lowest population density (9 people per Km2). Afar and Benshangul-Gumuz also have low population densities, with less than 13 people per square kilometre.

Population distribution

The Ethiopian population is concentrated in the highlands. Nearly half of the population lives at 2200 meters above sea level while 11 percent lives at altitudes below 1400 meters. The remaining 40 percent live between 1400 meter and 2200. Population density varies substantially with altitude. The highest population density prevails in some areas of the high land with 500 or more persons per square kilometer and the lowest with 10 or fewer persons per square kilometer in the lowland areas.

It is estimated that nearly 80 percent of the population live on 37 percent of the total area of the country while the remaining 20 percent live on the 63 percent of the country's land area.

Population Densities

The regions along the western and eastern borders of the country have low densities, with Gambela having the lowest of 9 inhabitants per km2. SNNPR has the highest density of close to 120 inh/km2. This is of course after the city-states of Addis Ababa and Harar and Dire Dawa. Table 1.3 shows the population densities in the various regions, and illustrates that some regions are considerably more densely populated than others.

Table 1.3: Population and Densities by Region, year 2003

No	Region	Total Population	Area km2	Densitynpop/km2
1	Tigray	4,113,000	56,452	73
2	Affar	1,330,000	92,371	14
3	Amhara	18,143,000	153,474	118
4	Oromiya	25,098,000	312,980	80
5	Somali	4,109,000	321,737	13
6	Benishangul	594,000	50,542	12
7	SNNPR	14,085,000	117,263	120
8	Gambela	234,000	25,649	9
9	Harari	185,000	394	470
10	Addis Ababa	2,805,000	526	5333
11	Dire Dawa	370,000	1,507	246
Total		71,066,000	1,132,895	63

Source: CSA Statistical Abstract 2003

Urbanization

The country is characterized by a small proportion of its population living in urban areas and at the same time by rapid rate of urban growth. For instance only 13.7 percent of the population lived in urban areas in 1998 a level much lower even by African standards and the rate of urban growth was estimated at 5 percent per annum.

Urban population

CSA classifies 15% of the year 2000 population as urban. In the CSA definition, an urban area is any town or conglomeration of houses with a population of over 2000 as well as administrative centres with fewer inhabitants. Occasionally, small settlements with some “town-like” characteristics such as frequent markets, a number of shops and other services

(i.e. not purely a rural village) are also counted as “urban”. In total 933 settlements have received the classification “urban”.

Tables 1.4 and 1.5 present the number of “urban” towns in each of the regions and their population. Of the 9.5 million urban populations, one-fourth lives in Addis Ababa. Another one-fourth lives in towns larger than 30,000 inhabitants, of which there are 36 (including Dire Dawa and Harar, excluding Addis Ababa). Most of these are in Oromiya regional state, some in Amhara, Tigray and SNNPR, none in Affar, Benishangul-Gumuz or Gambela. The 37 largest towns, each larger than 30,000 inhabitants and together accommodating just over 50% of the urban population, are listed in Table 1.6.

The other 50% of the urban population live in towns smaller than 30,000 inhabitants. There are 888 of these. Again, nearly half of this population (or ¼ of total urban) reside in 116 towns of 10,000 to 30,000 inhabitants. The rest lives in 780 small settlements of less than 10,000 people.

Table 1.4: Number of Towns by Population Group, Year 2000

Number of Towns by Population Group, Year 2000											
		Metropolis	**80 - 250,000**	**50 - 80,000**	**30 – 50,000**	**20 - 30,000**	**10 - 20,000**	**5 - 10,000**	**2 - 5,000**	**< 2,000**	**Totals**
1	Tigray		1		5	3	4	15	20	26	74
2	Affar						2	4	8	16	30
3	Amhara		3	3	1	6	24	36	78	57	208
4	Oromiya		3	3	6	12	35	61	144	112	376
5	Somali			2	1	4	8	18	20	19	72
6	Benishangul						1	1	7	4	13
7	SNNPRS		1	1	4	4	11	19	63	46	149
12	Gambela					1			3	3	7
13	Harari		1								1
14	Addis Ababa	1									1
15	Dire Dawa		1				1				2
	Totals:	1	10	9	17	30	86	154	343	283	933

Source: CSA 1999

Table 1.5: Population in Towns, by Population Group, Year 2000

		Metropolis	80 – 250,000	50 – 80,000	30-50,000	20 - 30,000	10 - 20,000	5 - 10,000	2 - 5,000	< 2,000	Totals
1	Tigray		128,974		186,621	70,362	54,087	101,919	55,871	24,168	622,002
2	Affar						29,986	31,380	28,108	16,510	105,984
3	Amhara		406,530	169,617	32,692	145,914	335,195	266,296	250,650	73,103	1,679,997
4	Oromiya		389,940	197,158	204,621	317,305	494,136	424,554	475,633	146,662	2,647,991
5	Somali			126,800	32,617	105,733	104,567	126,178	66,026	26,752	588,673
6	Benishangul						15,359	5,435	22,703	3,502	46,999
7	SNNPRS		94,010	54,395	171,120	90,669	160,643	127,178	202,732	57,246	957,993
12	Gambela					23,955			9,095	2,949	35,999
13	Harari		97,000								97,000
14	Addis Ababa	2,495,000									2,495,000
15	Dire Dawa		217,975				11,025				229,000
	Totals	2,495,000	1,334,429	547,970	627,671	753,938	1,204,998	1,082,940	1,110,818	350,892	9,508,657
	Cumulative	2,495,000	3,829,429	4,377,399	5,005,070	5,759,008	6,964,006	8,046,946	9,157,764	9,508,657	
	Percentages	26%	14%	6%	7%	8%	13%	11%	12%	4%	100%

Source: CSA 1999

Table 1.6 Population in Larger Towns

Population Group	Region	Town	Year 2003 Population
Metropolis	Addis Ababa	Addis Ababa	2,805,000
80 - 250,000	Dire Dawa	Dire Dawa	258,906
	Oromiya	Nazaret	208,116
	Amhara	Gondar	177,914
	Amhara	Dessie	154,469
	Tigray	Mekele	154,698
	Amhara	Bahir Dar	152,787
	Oromiya	Jimma	144,748
	Oromiya	Debreziet	119,393
	Harari	Harar	114,000
	SNNPRS	Awassa	114,127
	Somali	Jigijiga	88,531
	Oromiya	Shashemene	84,800
50 - 80,000	Amhara	Debre Markos	78,188
	Oromiya	Asela	77,051
	Oromiya	Nekemte	76,926
	SNNPRS	Arba Minch	66,034
	Amhara	Kombolcha	62,817
	Somali	Gode	62,397
	Amhara	Debre Berhan	61,423
	Tigray	Adigrat	59,642
	SNNPRS	Sodo	59,867
	SNNPRS	Dilla	55,657
	SNNPRS	Hosaena	52,311
30 - 50,000	Oromiya	Goba	46,106
	Oromiya	Ambo	44,988
	Tigray	Axum	43,261
	Tigray	Alamata	41,718
	Oromiya	Waliso	41,452
	Tigray	Endaselasie	40,195
	SNNPRS	Yirgalem	39,403
	Amhara	Weldiya	39,015
	Somali	Degehabur	39,086
	Tigray	Adwa	39,011
	Oromiya	Negele	39,106
	Oromiya	Arsi Negele	38,281
	Oromiya	Agaro	37,885

Source: CSA2003

Population Age Structure

The Ethiopian population is characterized by a young age structure with a median age of not more than 18 years a feature of rapidly growing population. The age distribution of the population for the last two decades and a half shows that the proportion of total population under 15 years of age was a little over 45 percent in 1970 and 1981, but it increased to 48 percent in 1984 and to 50 percent in 1990.

Proportion of working age population on the other hand declined from about 52 per cent in 1970 to about 44 per cent in 1990. The proportion of those aged 65 years and over increased from 3.2 per cent in 1970 to 6.2 percent in 1990.

Within the age structure those aged between 15 and 64 are considered the population of working age while those under 15 years of age and those 65 years and above are their dependents.

Dependency ratios have been increasing during the period 1970 to 1994. The youth dependency ratio increased from 88 dependants for every 100 persons of working age in 1970 to 114 in 1990 while the old age dependency increased form 6 in 1970 to 14 in 1990. One possible explanation for such a trend could be the increase in fertility and moderate decline in mortality rates.

Population data form the 1994 population and housing census have indicated a decline in overall dependency ratio from 128 in 1990 to 90.4 in 1990 to 83.8 in 1994. Old age dependency ratios still show a decreasing trend from 9.2 in 1984 to 6.6 in 1994.

Population Growth

Ethiopia entered the 20th century with about 11 million people. In 1960 this was doubled to 22 million. Another doubling took place after 27 years: in 1987 the country's population was estimated at 44 million. If current trends in population growth continue, there will be another doubling to 88 million people by the year 2012.

Two consecutive Population censuses have been conducted in 1984 and 1994. In 1984 the country was divided in 13 administrative regions plus Addis Ababa. The total population was then estimated at nearly 40 million, of which 89% percent was classified as rural. In 1994 the population had grown to 53.5 million, which implicates an annual growth rate of 3.0% over the 10-year period. Over the past 6 years the average national growth rate was estimated at 2.9% per annum.

The urban population has grown faster than average for the entire country: in the 10-year period from 1984 to 1994 at a rate 5.0%. The urban growth rate was 4.4% annually over the past 6 years. Urban growth rates appear to be somewhat higher in SNNPR and Oromiya than in the other regional states.

The fast urban growth is partly due to an increase in population in individual towns. In 1984 there were only 124 towns with more than 5000 inhabitants, at present there are 305 towns in that category. Also, there are more localities that fall within the CSA definition of "urban": in 1984 there were 629 localities classified as urban, in 2000 there were 925 towns. There are more "small towns" coming up. In 1984 Addis Ababa – with 1.4 million inhabitants - still accounted for 32% of the country's urban population, at present this has lowered to 26%.

Fertility

Fertility rates had been high and increasing up until 1990 and took a declining trend thereafter as revealed by the 1994 census. Total fertility, i.e. the number of children a woman would have during her lifetime if she were to experience the age specific fertility rates of the period, increased significantly form 5.2 in 1970 to 7.7 in 1990 moderate decline has been observed in 1984 whereby total fertility declined from 7.5 to 6.7 respectfully

Fertility appears to have increased in rural areas during the period 1970 to 1990 while in urban areas it increased between 1970 and 1984 and then declined moderately. In rural

Ethiopia, total fertility rate increased from 5.8 children per woman in 1970 to 8.1 in 1984 and 8.2in 1990. In urban areas, however, it increased from 4.7 children per woman in 1970 to 6.3 in 1984 but declined to 5.7 in 1990

The 1994 population and housing census results have revealed that urban fertility declined from 6.3 in 1984 to 4.5 in 1994 while rural fertility also declined from 8.1 in 1984 to 7.2 in 1994. The decline in urban fertility may partly be due to the rising age at marriage and partly due to the increasing use of contraceptives among urban women.

There is significant difference between urban and rural fertility. Rural women had nearly two and a half more children than the urban counter parts in 1990 (8.2 against 5.7). The corresponding figure for 1994 was more than two and a half more children (7.2 against 4.5). However, because of the fact that nearly 85 per cent of the total population is living in rural areas the national average total fertility rate is closer to that of the rural in 1990 (7.7 against 8.2) the corresponding total fertility fort the country as a whole stood at 6.7 in 1994.

Migration

Data are lacking to examine the scope and trends in migration in Ethiopian. However, both temporary and permanent internal migration has always been a common phenomenon of Ethiopian society. In the 1960s and early 1970s, for instance, partly because of the feudal type of land holding system and low productivity of peasant agriculture, and partly because of the expansion of mechanized farms, tens of thousands of persons migrated to the urban centres, and to the cotton and sugar plantations in the Rift Valley to work as seasonal labourers. A substantial number of the peasants and pastoral nomads lost their traditional farming and grazing areas when these lands were taken over by the emerging commercial farmers in the 1960s and early 1970s and as a result many migrated to coffee growing areas to work as coffee pickers or labourers in the expanding farms.

Significant rural-urban migration also existed in pre-1974 Ethiopia. Rural-urban migration accounted for half of the growth of the urban population in Ethiopia in the 1970s.

Local movement of people also continued because of the unpopular and coercive villagization and resettlement programs of the military government in addition to the more extensive movement of drought and war victims. In 1984, 16.4 percent of the total population enumerated by the Population and Housing census reported to be migrants.

There has also been some international migration of small magnitude up until the eve of 1974 revolution. After 1974 and up until 1991 population movements across international borders increased substantially due to drought, famine and war. Since 1991 migration to North America, Europe, and the Middle East has increased tremendously in search of employment and better opportunities.

Population Projections

CSA has made population projections up to the year 2030 and has considered three variants. In the first – high growth – variant it is assumed that the government makes some attempts to reduce the current high level of fertility, but that the effectiveness of various approaches and program is very limited. In a medium variant it is assumed that the effectiveness is moderate, while in the third – low growth – variant it is optimistically assumed that fertility rates will decrease at an accelerated pace. Table 1.7 shows the three forecasts. (See also figure 1.2).

Table 1.7: Population forecasts, 3 variants, in million people

Year	Low variant	Medium variant	High variant
1994	53.5	53.5	53.5
2000	63.2	63.5	64.0
2010	80.2	83.5	87.6
2020	99.2	106.0	116.0
2025	108.9	117.6	132
2030	118.1	129.1	149.4

Source: CSA 1999

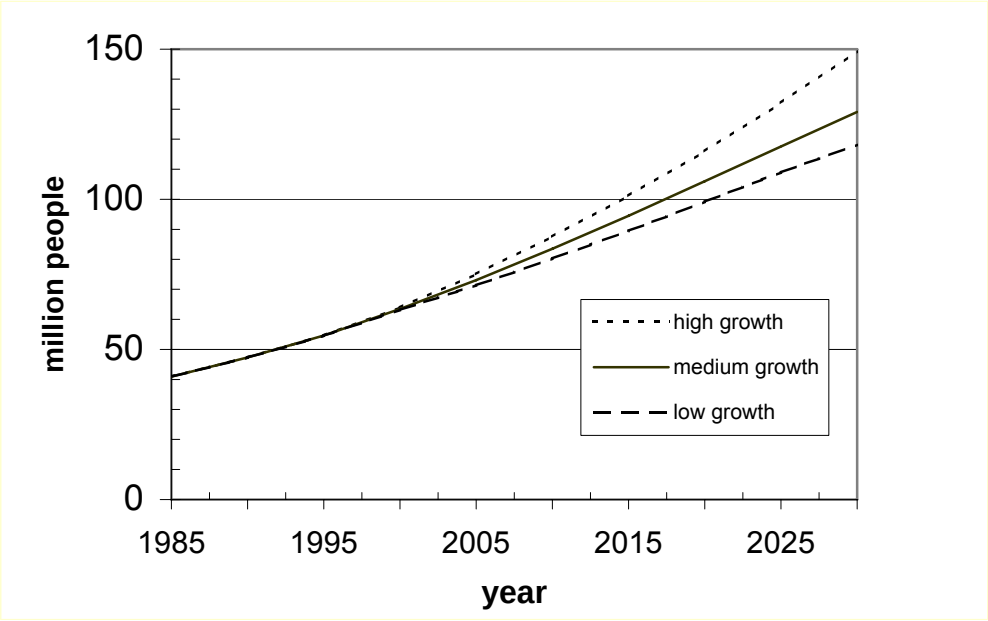
In the first, high variant the annual growth rates (country average) increase to 3.3% over the coming 5 years and then slowly decrease to 2.5% in 2030. The middle variant sees a decreasing growth rate down to 1.9% in 2030. In the optimistic variant this decrease is accelerated and reaches 1.6% in the same year. Table 1.8 lists the various projected growth rates of the three variants.

Table 1.8: Projected annual growth rates, 3 variants

Growth variant:	Low			Medium			High		
5-year period	Total	Rural	Urban	Total	Rural	Urban	Total	Rural	Urban
1995 – 2000	2.94%	2.69%	4.45%	3.05%	2.80%	4.54%	3.19%	2.94%	4.70%
2000 – 2005	2.46%	29%	3.95%	2.84%	2.58%	4.27%	3.26%	3.00%	4.68%
2005 – 2010	2.37%	2.08%	3.89%	2.71%	2.41%	4.21%	3.13%	2.83%	4.67%
2010 – 2015	32%	1.90%	3.70%	2.52%	29%	4.02%	2.94%	2.60%	4.49%
2015 – 2020	2.08%	1.73%	3.54%	2.32%	1.97%	3.81%	2.77%	2.41%	4.31%
2020 – 2025	1.88%	1.51%	3.35%	20%	1.71%	3.59%	2.63%	33%	4.16%
2025 – 2030	1.64%	1.21%	3.14%	1.88%	1.44%	3.42%	2.48%	2.04%	4.03%

Source: CSA 1999

Figure 1.3: Population Forecasts, Entire Country



Urban population projections

The urban proportion of the population is to grow further, according to CSA from the present 15% to 23% in 2030, independent of the growth variant. For the medium variant this would result in an urban population of nearly 30 million people, tripling the present number.

CSA has applied the urban growth projections on the 933 towns classified as such in the year 1994 census. The group-wise year 2000 population estimates of these towns were presented in table 1.5. Over the years each town will clime up the ladder and arrive in a next population group. For example, a town with 15,000 inhabitants in 2000 would have some 45,000 people by the year 2030.

Table 1.9 presents projected number of towns by population and by town-group. The projection has been made applying averaged urban population growth forecasts per region as these are used by CSA in its medium variant.

Table 1.9: Projected numbers of towns per category

Years:	Number of towns per town group						
	2000	2005	2010	2015	2020	2025	2030
Addis Ababa	1	1	1	1	1	1	1
> 250,000		1	2	5	7	9	12
80 – 250,000	10	14	17	18	23	37	46
50 – 80,000	9	8	17	30	34	35	50
30 – 50,000	17	31	34	40	59	68	74
20 – 30,000	30	37	52	57	61	78	99
10 – 20,000	86	103	123	156	192	221	232
5 – 10,000	154	194	231	248	258	263	254
2 – 5,000	343	345	319	287	233	180	132
< 2,000	283	199	137	91	65	41	33
Totals:	933	933	933	933	933	933	933

Looking at table 1.9, the first observation is that there will be a tremendous increase in the number of larger towns: the number of towns with more than 30,000 inhabitants will increase by a factor 5: from 36 to 182 (excluding Addis Ababa). For the medium-sized towns this increase is less strong: in the order of a factor 3 and less.

The table shows a decrease in the number of small towns, i.e. smaller than 5,000 inhabitants. This is caused by the situation that – in the calculations – the total number of towns is kept at 933. In reality these smaller-town groups will be fed by settlements that at very small at present. For example, a settlement with 700 inhabitants in the year 2000 will - by 2030, and assuming uniform growth rates over all categories – have passed the 2,000 mark, at which level it classifies itself as town.

1.2.4.2 Economic Performance

With per capita GNP of $100 in 1994, Ethiopia ranks as one of the poorest countries in the world and certainly within Sub-Saharan Africa. In contrast, per capita GNP in other East African countries ranges from $ 140 in Tanzania to US$250 in Kenya. In 1994 per capita incomes in Ethiopia were less than half of those in Sub-Saharan Africa as a whole, where per capita GNP was approximately $259 and less than one third of those in low-income countries which reported per capita GNP of $360 on average in the same year.

Along with very low per capita income, the number of people falling into poverty in Ethiopia is also very high. It is estimated that nearly 52% of the population is poor. Poverty in urban areas was estimated at 58%, while rural poverty was approximately 48%.

Income is highly variable from year to year. Long-term variability is partly due to frequent and severe droughts, which have plagued the rural population. The country is largely dependent on the agriculture sector, which provides 86% of employment and 57% of GDP.

1.2.4.3 Education

Policies and strategies

The general objectives of the policy issued in 1994 are: to develop the physical and mental potential and problem solving capacity of the individual; to bring up citizens who can take care of and utilize resources wisely; to bring up citizens who respect human rights, stand for the well-being of people, as well as for equality, justice and peace, endowed with democratic discipline; to bring up citizens who differentiate harmful practices from useful one, who seek and stand for truth, appreciate aesthetics and show positive attitude towards the development and dissemination of science and technology in society.

The strategies set to achieve the policy objectives include: establishment of vocational/technical training system in parallel to the academic system; restructuring of educational organization and administration in accordance with the devolution of power to the regions; upgrading of training and professional competence of teachers with a view to improve the quality and standard of education; educational services expansion and provision of materials at all levels of education; strengthening the link between academic research and production; and improving financing of educational system.

According to the 1994 policy, the education structure has changed to 8-2-2 (primary-middle-secondary) giving more emphasis to the vocationalization of the education system and enhancing problem solving capacity of students. The school structure for more than 25 years was 6-2-4 up until the policy of 1994.

Primary Education

Ethiopia has one of least enrolment rates, which according to the reports of the Ministry of Education, was 23 and 34.6 percent in 1993/94 and 1995/96, respectively, for grades 1 to 6. Apart from the low level of enrolment ratio, primary education in Ethiopia suffers from persistent disparity between sexes. Estimates of some 6 years back indicate that 30 to 40 percent fewer girls than boys attended school at national level. The indicators for rural areas signify an even worse condition. Girls on average account for about 37.3 percent of total primary school participation in 1995/96.

Primary education enrolment rates increased successively during the years 1992/93 to 1995/1996. It increased by about 15 percentage points reaching 34.6 per cent by 1995/1996. Though enrolment rates of both boys and girls increased during this period, the participation gap has widened from 7 to 17 percentage points.

Secondary Education

Secondary education in Ethiopia has long been divided into two sub-phases namely Junior and senior secondary education, i.e., 2 years of junior and 4 years of senior secondary years. According to the new policy, however, the former 2 years of junior schooling has been made part of the primary education. The new secondary education is also divided into two cycles where grades 9 and 10 are the end of general education and grades 11 and 12 are considered as the preparatory levels for tertiary education.

Enrolment in secondary education has increased rapidly in line with growth in the number schools. According to sources from the Ministry of Education, enrolment in secondary education (7-12) during 1992/93 stood at 712,489 which further rose to 889081 in 1996/97 showing an annual average growth rate of 7.3 and 4.0 percent, respectively during the period 1992/93-1996/97. The number of secondary schools has also shown an annual average growth of 7.5 percent per annum over the same period.

1.2.4.4 Health Data

The health status of Ethiopians is extremely poor, even in comparison with the Sub-Saharan Africa region and other low-income countries. In general, the poor health status of Ethiopians can be characterized by vulnerability to largely preventable infectious diseases and nutritional deficiencies, including micronutrient deficiencies. Ethiopia's historically high rate of population, their low education levels and high rates of illiteracy, inadequate access to clean water and sanitation facilities, and poor access to health services have all contributed to this burden of ill health. The country's long civil war has not only exacerbated problems of poor heath and low incomes among the war's victims, but also led the deterioration of the health infrastructure and, until recently, diverted resources away from investments in the health sector

Table 1.10 documents the burden of ill health in Ethiopia to its neighbours. For example, the crude death rate in Ethiopia is approximately 18 per 1,000 populations, more than double that of neighbouring Kenya and second only to Uganda in Eastern Africa. Life expectancy at birth is 49 years. Although Ethiopia has made significant progress in reducing mortality rates since 1980, both infant and child mortality remain substantially higher than those of the Sub-Saharan Africa region as a whole. Infant mortality in 1994 was approximately 120 deaths per 1.000 live births, while the child mortality rate was 204.

Table 1.10: Basic Health Status indicators

	Ethiopia	Eritrea	Kenya	Tanzania	Uganda	Africa
Crude Death Rate (Per 1000)	18	15	9	14	19	15
Life Expectancy (Years)	49	46	59	51	42	52
Child Mortality (Per 1000)	120	135	59	84	122	92
Maternal Mortality (Per 100000)	452-1528[b]	….	510-646	200-748	550	573
Immunization Coverage (Percent)						
Diphtheria, pertussis, and Tetanus	28	…	85	82	73	50
Polio	28	…	85	81	74	50
Measles	22	…	76	79	73	51
Access to proper Sanitation (Percent)	10	…	49	46	67	26[a]
Access to Safe Water (Percent)	18-26	….	….	52	….	37[a]
Access to Health Care (Percent)	55	…	…	93	…	54[a]
Attended Births (Percent)	10	…	…	60	….	34[a]

…. No data.

a Excludes South Africa.

b Maternal mortality estimates for Ethiopia vary widely depending on source used.

Source: World Bank 1996a, 1996b: 1994a:PHRD Study Number 4, 1996.

Deaths per 1,000. In general, high infant mortality is partly attributable to high prenatal (28 weeks of gestation to first week of life) and neonatal (birth to one moth) deaths. These deaths in turn are often due to poor maternal health. The deaths of children older than one month are generally caused by disease and malnutrition (WHO 1986). Estimates of maternal mortality vary widely between 452 and 1,528 deaths per 100,000 live births in Ethiopia. While the lower end of that range is comparable to maternal mortality in neighbouring countries, the upper limit is more than double the high-end estimates of other countries in Eastern Africa.

As will be discussed in greater detail, coverage of basic health services and infrastructure is remarkably low in Ethiopia. Table 1.10 indicates that child immunization rates in Ethiopia are 28 percent each for DPT and polio and 22 percent for measles. Only 10 percent of Ethiopians have access to proper sanitation facilities, and 17 to 26 percent to safe water. The availability of both is highly skewed toward urban areas. In contrast. 26 percent of the population of Sub-Saharan Africa as a whole has access to sanitation. Finally, it is estimated that only 10 percent of all births in Ethiopia are attended by trained health personnel, compared with approximately 60 percent in Tanzania and 34 percent in Sub-Saharan Africa over- all.

The major causes of morbidity among patients seeking treatment in health facilities include respiratory infections, malaria, skin infections, diarrhoea diseases, and intestinal parasitic infections. For children, these five illnesses accounted for over 63 percent of all reported cases of child morbidity. Among those receiving in-patient care in hospitals, tuberculosis and malaria account for 30 percent of all in-patient deaths. Other important diseases leading to premature death include prenatal and maternal complications. AIDS, and nutritional deficiencies. Some of these health problems have become more prominent in recent year, most notable malaria, TB and HIV/AIDS. In particular, HIV/AIDS is becoming an increasing threat to the population of Ethiopia. The capital city, Addis Ababa appears to be affected by the epidemic more than other regions.

The analysis in Table 1.11 presents discounted life year (DLYs) lost owing to premature death from a variety of diseases. Conceptually, a comprehensive measurement of the burden of disease should capture all possible short-and long-term consequences of disease and injury, which would be classified as acute or chronic disability as well as death. While the exclusion of disability impacts in this analysis may lead to a slight reordering of the actual results and prevents a thorough analysis of the economic implications of disease, an advantage of using only death to measure the burden of disease is that death is an unambiguous event and availability of data is better than for a wide spectrum of possible disabilities.

The total burden of disease in Ethiopia is approximately 350 DLYs lost per 1,000 people (PHRD Study Number 3,1996). Ethiopia 's burden of disease is significantly higher than in neighbouring Kenya, which is estimated to be approximately 170 DLYs lost per 1,000 people. It is also much higher than Eastern Africa as a whole, which has a burden of disease of 289 DLYs lost per 1,000 people

Table 1.11: Burden of Disease for Ethiopia

Conditions	Population Group	Deaths (Percent)	DIYs Lost (Percent)	Mortality Rate per 1000	Untreated CFR (Percent)	Average Age at Death	Lost if Die
AIDS	All	7.7	8.1	1.32	1000	27	26.2
ARI	Under 5	14.4	17.1	13.33	15.4	2.0	29.0
Cardiovascular	15+	0.9	0.8	0.27	45.0	40.0	22.9
Diarrhea	Under 5	7.6	9.0	7.03	0.4	2.0	29.9
Injury/Trauma	All	0.9	0.8	0.15	----	34.0	24.5
Malaria	All	10.0	10.9	1.71	10.0	20.0	27.5
Measles	Under 5	3.5	4.1	3.22	3.0	1.5	30.0
Nutritional Deficiency	Under 5	7.8	9.3	7.20	12.0	2.0	29.9
Perinatal-Maternal	Preg. Woman +Births	16.8	16.3	----	----	25.0	26.6
Tuberculosis	All	4.8	4.8	0.82	44.6	30.0	25.5
Total Target Diseases		74.3	81.3			53.0	18.3
All other Diseases	All	25.7	18.7			53.0	18.3
Total	All		100.0	100.0			

Source: PHRD Study Number 3, 1996

Ethiopia's burden of disease is dominated by acute respiratory infection and parental and maternal conditions followed by malaria, nutritional deficiency, diarrhoea, and AIDS. Indeed, the top 10 causes of mortality account for 74 percent of all deaths and 81 percent of DLY s lost. Diseases that affect children under the age of 5 years (ARI) account for 33 percent on deaths and 40 percent of DLYs lost, although children under 5 represent well under 20 percent of the population. When perinatal and maternal conditions are added, the health problem of mothers and children combined account for 50 percent of all account for 50 percent of all deaths and 56 percent of DLY s lost. Although largely prevent able, childhood and maternal illnesses and communicable diseases are the major causes of death in Ethiopia.

1.3 National Water Policy

The Ethiopian Water Resources Management Policy outlines some fundamental policy principles based on Dublin-Rio statements (1992). These are summarized in the following paragraphs:

- Ethiopian citizens shall have access to sufficient water of acceptable quality to satisfy basic human needs. The policy gives top priority to drinking water supply over other uses;
- Water is both an economic and social good;
- Water resources development should be based on rural cantered, decentralized management and participatory approaches. This focuses on promoting decentralized management, foster the participation of user communities and support community self-initiatives in water resources management.
- Management of water resources shall ensure social equity, system reliability and sustainability;
- Integrated Water Resources Management is emphasized in the policy document and thus the policy recognizes the hydrologic boundary or basin as the fundamental planning unit and water resources management domain. Increasingly, river basin is emerging as a unit of management of land, water and other natural resources in an integrated fashion. The Water Sector Development Program as an instrument for implementing the water resources management policy too advocates the establishment of River Basin Authorities becoming an integral part of Ministry of Water Resources.

1.4 Indicators

Table 1.12: Indicators for chapter 1

Indicator	2002…. 2015
• Total Population • Population Growth Rate • Population Density • Percent of Population in Urban Areas • Total Fertility Rate • Life Expectancy at Birth • Health-Adjusted Life Expectancy (HALE) • Adults Ages 15-49 Living With HIV or AIDS • Net School Enrolment Ratio (NER) • Unemployment • Adult Literacy Rate • Adjusted Net Savings as a Percent of GNI • Average Annual Growth Rate • Employment Distribution by Sector • Gross Domestic Product (GDP), Constant 1995 Dollars • Income Inequality • International Poverty Line • Net National Savings as a Percent of GNI • Percent Share of Income • Population Living Below $1/day • Poverty Gap • Purchasing Power Parity, per capita • The GINI Index • Crude Death Rate (Per 1000) • Life Expectancy (Years) • Child Mortality (Per 1000) • Maternal Mortality (Per 100000) • Immunization Coverage (Percent) • Access to proper Sanitation (Percent • Access to Safe Water (Percent)	

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Chapter 2

2 Governing Water Wisely

Introduction

Sustainable development of water resources and effective governance are inseparable. Water governance generally refers to the wide range of social, economic, political, institutional, administrative systems and decision-making processes.

Such systems exist to regulate the development and management of water resources and provision of adequate, safe and reliable water supply services. The fact is that inadequacies and incompetence of institutional arrangements and legal frameworks do seriously affect water governance. The weaker the stance of water governance, the deeper is the crisis in water resources management and development.

Governance generally embraces the entire framework of decision-making process. It stipulates who makes what kinds of decisions, when, and according to what criteria, norms and operational values. Such decisions range from those that are made at lower government institutions, which mainly deal with day-to-day operational and functional issues, to those that are made at higher levels.

Successful implementation of water policies, strategies, programmes and projects are dependent on all the stakeholders working at different levels. These are stakeholders sharing common vision regarding sustainable development and management of water resources.

Effective governance can only be then realized through the existence and proper functions of relevant public, private, NGOs, international development partnering agencies and community based organizations etc.

The issue of governance is taking its momentum in the context of Ethiopia's social, economic and political systems. Issues of institutional linkages, coordination, collaboration and effective participation and involvement of stakeholders has continued to become the concern of government and those institutions that are partnering with government in the areas of social and economic developments.

2.1 Institutions

2.1.1 Federal Institutions

Referring to the history of water institutions in Ethiopia, the first modern type of water sector institution is known to had been created in 1956 as "Water Resources Department" under the then Ministry of Public Works. Since then the water sector in Ethiopia has passed through considerable institutional changes and development. Before a Federal Political system was established in the early 1990s, water sector institutions such as the Water Resources Commission, Water Resources Development Authority, Water Supply and Sewerage Authority, the Ethiopian Valleys Development Studies Authority were organized

as centrally placed national organizations with the jurisdictions to operate and function all over the country based on the tasks and roles stipulated by law to each one of them. Some of them had branch offices in the then Regional Administrations and some had not.

However, with the coming into being of the Federal political system and a market oriented economic system in 1992, the organizations are either restructured to suit the new political and economic orientation or they are altogether dissolved or disbanded losing their functions and existence. Their continued existence without making changes in the institutional set up of respective organizations has been found irrelevant and calling for major institutional changes. However, although frequent restructuring of Water institutions with the objective of bringing about efficiency, effectiveness, linkages, coordination and collaboration is a common phenomenon in Ethiopia, there is still lack of effective coordination among stakeholders in general. Coordination among key stakeholders such as Federal and Regional Public water Institutions, NGOs, Multilateral and bilateral agencies and the private sector itself is still an issue that still needs improvement.

Since the early 1990s many water sector institutions have continued to newly create at Federal and Regional levels.

Pursuant to the Declaration of the Millennium Development Goals by the United Nations in 2000, the government of the Federal Democratic Republic of Ethiopia has continued to further devolve decision-making process, planning and implementation of social and economic activities down to the local levels.

The decentralization and regionalization policy has been an enabling environment for the establishment of water institutions at different levels.

The institutions that exist at Federal level are directly or indirectly involved in the development and management of water resources. Of the institutions that are to be mentioned in this regard are:

- Ministry of Water Resources (MoWR)
- Ethiopian Electric Power Corporation (EEPCO)
- Ethiopian Electric Power Agency (EEPA)
- Ministry of Agriculture and Rural Development (responsible for small-scale irrigation)
- Ministry of Federal Affairs
- Ministry of Health
- Environmental Protection Authority
- Ministry of Infrastructure
- National Meteorological Service Agency
- Ministry of Mines and Energy
- Geological Survey of Ethiopia
- Water Resources Development Fund Office
- Ethiopian Social Rehabilitation and Development Fund (engaged in water supply and small-scale irrigation development activities)

- The Addis Ababa Water Supply and Sewerage Authority (it is included in this list not because it reports to the federal government directly, but because its services are for dwellers of the Federal City and the Federal Political, Social and economic entities functioning within the city proper).

In this paper, it has been found not important to discuss the detailed functions, duties and responsibilities of these institutions, there is a strong belief names of each of the institutions are self-explanatory and deeming not necessary to do so. However it would be worthwhile to mention that the Geological survey of Ethiopia has prepared hydro geological map covering 30% of the country in 1:250,000 scale and is currently engaged with collaboration of the Ministry of Water Resources and the Ethiopian Science and Technology commission in the undertaking of National Groundwater Assessment Programme, an activity which is very important to investigate the real potential of groundwater resource in Ethiopia in terms of its special distribution. This will help to utilize it for irrigation, something that the country has not done it so far, except for drinking water for humans and livestock.

However, there is one important thing to make in connection to the duties and responsibilities of one of the aforementioned institutions. The Water Resources Development Fund Office has been recently established by Government Proclamation with the objectives, duties and responsibilities to give loans to Urban Water Supply Services, which are legally constituted as autonomous entities entitled to operate on full cost recovery basis for both investment costs and maintenance and operation costs.

In addition, this office provides loans to irrigation schemes on cost recovery basis. The office has been established following the completion of the 15-year Water Sector Development Programme (WSDP) for Ethiopia beginning 2002.

The programme was developed with the purpose of meeting the MDGs and also in view of its additional contribution to the overall socio-economic transformation of the country.

At the Federal level, in addition to those that are listed above, there are organizations that are subsidiary to the MoWR as they are established by law as public enterprises.

Although they are autonomous entities, they still report to the Ministry of Water Resources as its subsidiary on issues related to water resources planning, development and management. The organizations are the following:

- Water Works Design and Supervision Enterprise (WWDSE)
- Ethiopian Water Works Construction Enterprise (EWWCE)
- Water Well Drilling Enterprise/WWDDE)
- Awash Basin Water Resources Management Authority (the only basin institution which is currently operating for one of the major river basins in the country)

2.1.2 Regional Institutions

There are nine regional states and two city-states under the umbrella of the Federal Democratic Republic of Ethiopia. All have established Bureaux for Water, Mines and Energy or Bureaux for Water Resources Development.

Some of the regional states have in addition established specialized institutions as Irrigation Commissions, Irrigation Authority, Water Works Construction Enterprises and Commissions for Sustainable Agriculture and Environmental Rehabilitation.

With the further decentralization process of planning and implementing to the lowest administrative units called Woredas (local) since the past two to three years, a restructuring process of the Regional water institution has continued to the present.

Planning and implementing of water resources development and management, which are within the legal competence of the Regional States are further devolving down to the local administrative units. Regional bureaux and those that were at zonal level are giving way for some of their duties and responsibilities to the woredas. Some of the specialized institutions are getting restructured losing either their regulatory functions or operations related to their specific sector responsibilities. There is no clear data for the moment how many of the specialized institutions have been altogether disbanded or lost some of their functions

In terms of the duties and responsibilities that had been entrusted upon the regional water bureaux and the other specialized agencies like Irrigation commissions/authorities, water construction enterprises and drilling enterprises, they have been actively working on developing small scale irrigation schemes, which includes study, design and construction. In addition water supply schemes have been constructed and maintained and operated using the competence of these organizations. In the regions that have relatively better capacity to plan and implement, the enterprises are organized to undertake construction activities and also give maintenance services using their crew established for such purposes. But with the advent of decentralization of planning, budgeting and implementing of projects/programmes at Woreda (local) level a lot of institutional arrangements and reorganizations are still going on in the regions.

2.1.3 Local Level Institutions

The Woreda decentralization process has enabled the creation of Woreda water desks. These desks are responsible for planning, budgeting, implementing and monitoring and follow-up of water projects and programmes, in their respective localities.

It is not so far clear how many of the woredas existing in each of the Regional states have been able to organize Woreda Water Desks. It is however known that the four Regional states (Amhara, Tigray, Oromia and Southern Nation) have gone a little far in terms of creating these Woreda Water Desks. These local Water Desks are reporting to a Woreda level government administrative body called Desk for Rural Development not directly to the Regional Water Bureaux. The Rural Development government body that exists at the Woreda (Local) level is reporting to the Woreda Administrative Council the locally based highest authority.

2.1.4 Private Institutions

There are no many private institutions that are involved in the development and management of water resources. Very few have started engaging in consultancy services in the areas of water and related projects. Reliable data could not be found to tell exactly how many of them are effective in their undertakings. Some of them have few permanent technical and professional staff and most do not have. There are also very few small water well drilling companies specialized in water works. Again data and information that is worth reporting is not available at the moment.

They lack machinery, equipment, adequately trained staff and management skill, which are believed to take them some more years before they become efficient and capable. But, in the case of some few consulting engineers, their presence in the business is an indication

of their value added contribution to the effectiveness of meeting the MDGs and Government plans in general.

There are no private water companies that are engaged in providing water supply services. The informal sector usually involves to a limited extent in the maintenance of small water supply schemes in the rural areas and in urban centres most often around households that are willing to offer such jobs. There are no either specialized private water companies that could supply water for irrigation development.

2.1.5 Indicators

Challenge Area: Governing Water Wisely (Water Governance)

Specific Aspect of the Challenge: Institutions

GWIo1: Number of Federal Institutions

Definitions for GWI01: To have a clear number of institutions at the Federal level who are involved directly or indirectly in the development and management of water resources.

There are eleven federal level institutions and four main subsidiary organizations to the Ministry of Water Resources involved directly or indirectly in water resources development and management of the country, namely:

- Ministry of Water Resources (MoWR)
- Ministry of Agriculture & Rural Development (MoA&RD)
- Ethiopian Electric Power Corporation (EEPCO)
- Ethiopian Electric power Agency (EEPA)
- Ministry of Federal Affairs
- Ministry of Health
- Ministry of Mines and Energy
- Ministry of Infrastructure
- National Meteorological Service Agency
- Water Supply and Sewerage Authority (for the city of Addis Ababa)
- Ethiopian Environmental Protection Authority (EPA)
- Ethiopian Social Rehabilitation and Development (ESRDF)
- Water Resources Development Fund Office (WRDF)

Subsidiary Organizations to the Ministry of Water Resources:

- Water Works Design and Supervision Enterprise
- Water Works Construction Authority
- Water Well Drilling Enterprise
- Awash Basin Management Authority

*** GWI: Governing Water Indicator**

GWI02: Number of Institutions at Regional level:

There are at least the under listed sector institutions at regional levels

- Water, Mines and Energy Bureaux
- Water Resources development Bureaux
- Bureau of Health
- Water Resources Development Commissions
- Irrigation Development Authorities
- Sustainable Agriculture and Environmental Rehabilitation Offices
- Water Works Constructions Enterprises
- Bureaux for Agriculture and Rural Development
- Regional Social Rehabilitation and Development Fund Offices.

GWI03: Number of Institutions at Local levels (Woreda levels)

As Woreda decentralization has still continued to take place, there is no data or information as to how many Woredas (local) Water Desks have so far been put in place/are established.

GWI04: Number of private institutions involved in water resources development and management:

No reliable data and information is available for the moment. There are unconfirmed figures as to how many are engaged in consultancy services and in drilling.

There are not more than eight consulting firms specializing in water and water related study and design activities and few are also known to be available in the area of water well drilling enterprising. No water company has every started business in the provision of drinking water supply services and irrigation. By law and policy private companies are encouraged to be involved in developing water infrastructures for irrigation and hydropower generation.

2.2 Legislation

This topic, for our purpose, sticks mainly to the legislative framework created for the implementation of the water proclamation and the operational of the Ethiopian Water Resources Management policy.

Development of the water policy, formulation of the national water sector strategy, the issuance of water resources management proclamation and the preparation of the 15-year Water sector Development Programme (WSDP) beginning 2002 and in addition Ethiopia's effective involvement in the Nile Basin Initiative among others, are signs of effective governance by way of creating the ground for sustainable water resources development and management.

Focus will be given in this section for the Water Resources Management Proclamation issued in 2000(FDRE, 197/2000) and the Water Resources Management Regulations, which is due to be approved soon by the Council of Ministers before the end of 2004.

2.2.1 Water Resources Management Proclamation

The proclamation was issued with clear objectives and purpose to implement the, fundamental principles objectives, goal and the stipulated sectoral and crosscutting policy issues articulated in the water policy for Ethiopia. The proclamation has Nine Parts and 33 Articles and several sub-articles. The social, legal, environment, institutional and many more other related legislative provisions are treated here as appropriate and required. The proclamation declares, "All water resources of the country are the common property of the Ethiopian people and the state". (Federal Democratic Republic of Ethiopia (FDRE), 197/2000 Article 5)

Regarding water use priority, the proclamation states, "Domestic water use shall have priority over and above any other water uses". (FDRE,197/2000 Article 7sub-article 1)

According to the Ethiopian Water Resources Management Policy every citizen has the fundamental right to access safe water for his/her basic needs. The fundamental principle issued by government in relation to this issue states that "As for as conditions permit, every Ethiopian citizen shall have access to sufficient water of acceptable quality to satisfy basic human needs"(Ethiopia Water Resources Management Policy, Chapter 3).

According to the proclamation, the right to allocate and apportion water to all regional states regardless of the origin and location is best bestowed upon the legal jurisdiction of the Ministry of Water Resources in its capacity as supervisory body.

The legal provisions in the proclamation with regard to ownership of the resources and its allocation and apportionment clearly shows that the development, management, utilization and protection of all water resources in the country lines effectively in the hands of the Federal Government.

The fact that the Federal Ministry of Water Resources is the responsible government agency to draft water law and submit it to the Federal Council of Ministers, and further to be deposited to the Council of Peoples Representative (the Federal Parliament) for it ratification testifies that there is no other law or water legislation to be used and issued at Regional and local levels. In effect, there is one national water policy and one water proclamation to be effective at all levels. But, the Ministry, where necessary, delegates its powers and duties to the appropriate body for efficient execution of its duties and power. Regional states and local administrative bodies, without requiring any new law for water are strictly obliged by law to implement the water policy and the water proclamation in accordance with set directives and guidelines to be provided by the Federal Ministry of Water Resources.

2.2.1.1 Ministry's Duties and Powers

- The Ministry of Water Resources has among others, the following duties, responsibilities and powerIssue water use permits and certificates of professional competence,
- Approve, reject, or amend plans and proposals from any person who apply for permit to undertake any kind of waterworks;

- Establish quality standards for surveys, design and specification of water works and standards for the construction of water work. It also supervises the compliance of the same using set standards.
- In consultation with other specialized and competent concerned public authorities ensures water resources are not polluted and hazardous to health and the environment.
- Again in consultation with other public bodies, issuance of quality or health standards to entertain an application for permit to discharge or release polluted water into water resources.
- Giving an order of rectification or supervision of water works that are not compatible or not consistent with the Water Resources Management Policy, relevant Basin Master Plan Studies and Water Legislative Framework, and ensure its implementation.
- Issue directives pertaining to the safety of hydraulic structures for the prevention of damages caused by dams to persons, property etc. Responsible officials in the Ministry say, "Implementation of the Water Proclamation is long over due to a delay in the approval process of the Regulation". However, the same sources say that the Regulation could be approved before the end of 2004.

As issuing water use permits and licensing of professional competence is within the legal jurisdiction of the Ministry, it has been known that several applications have been submitted to the competent department in the Ministry, from water consultants, water works contractors and others, which are covered in the proclamation. The Water Resources Administration and Urban Water Supply and Sanitation Service Department, the concerned office in the Ministry for issuance of permits and certificates of professional competence, says not less than 250 applications are already submitted to it, pending approval of the Ministry.

The Ministry is now getting ready to issue temporary permits and licenses. In addition some few guidelines such as, water quality Guidelines and procedures and irrigation development guidelines are known to have prepared and got the clearance from the Ministry for official use.

2.2.2 Water Resources Management Regulation

As the draft Water Resources Management Regulation is still pending, but shortly expected to be approved by the competent public authority mentioned earlier, it will be of less important to discuss it here. However, it has been made clear that the contents of the Regulation are those covered in the proclamation, but detailing the procedures as to how the various legal materials contained in the proclamation are to be effected on the ground. The Regulation has TEN PARTS and 44 relevant Chapters (Articles).

2.2.3 Water Rights

Water Rights issue in Ethiopia can be explained from two perspectives or from social equity and economic efficiency point of view. Consistent to underlying Government laws and international conventions, every Ethiopian citizen has the fundamental right to have access to safe domestic water for basic needs. Citizens in Ethiopia, as conditions permit, shall not be left without safe water, no matter their capacity to afford for the services providedThe other aspect water Right issue in Ethiopia are those related to persons, public or private organizations that have the desire and plan to involve themselves in the development and management of water resources. As long as these entities request or apply for water permits and certification of their competence within the set legal framework and operational

procedures, they are rightly entitled to involve in water resources development and management regardless of its origin or location within the territorial boundary of the Federal Democratic Republic of Ethiopia.

2.2.4 Indicators

Challenge Area: Governing Water Wisely (Water Governance)

Specific Aspect of the Challenge: Legislation

GWI 05: Existence of Legal and institutional arrangement for an improved water resources development and management at a national level

Definition for GWI 05: Ensuring that the national water resources management in Ethiopia is strategically directed, supervised and integrated with other social, economic and Environmental sectors.

Since the establishment of a Ministry for the water sector in 1995/96, a strategic and participatory approach has been instituted by bringing into place key sector reforms/initiatives as indicated below.

Sector Reforms	**Years**
Ministry of Water Resources established	1995/96
Regional Water Bureau Created	1994/95
National Water Policy issued	1999
Water Sector Strategy Development	2001
Water Resources Proclamation Issued and ratified	2000
Water Regulation drafted	2004

Basin Master Plan Studies Since 1990-2004

- Five master plan studies completed and legally endorsed and two on-going master plan studies, started in 2003
- National Water Supply and Sanitation Master Plan Development (2003)
- Ethiopian Guidelines for Drinking Water Quality Developed and endorsed (2002)

GW 06: Water Rights Defined

Definition for GWI 06: The legal and institutional contents as to how citizens can have access for water to meet their basic needs, and water demanded by other public and private entities for economic investment purposes.

The Law and policy recognize Water Rights for basic needs in view of fulfilling social equity. Rural communities have continued to be provided with safe water in as long as they fully cover costs for maintenance and operation. For those living in urban centers but cannot afford for the services provided are accommodated for subsidies depending on the social and economic situations that they live.

Public and private agencies and persons applying for water use permit and certification of their technical and professional competence have the full right to use any water resources provided they fulfill requirements set by the Supervisory body.

GWI07: Ownership of Water Resources defined by law and policy.

Definition for GWI 07: The legal and institutional framework under which the national water resources is administered and managed, and the extent to which that responsible body has the necessary power and competence adequately defined.

The Ethiopian Water Policy and Water proclamation clearly stipulate that all water resources (surface + Groundwater) are common property of the people of Ethiopia and the state. The necessary legal and institutional arrangements have continued to be established for this purpose.

GWI 08: Ownership of Water Resources defined by law and policy.

Definition for GWI 08: The legal and institutional framework under which the national water resources is administered and managed, and the extent to which that responsible body has the necessary power and competence adequately defined.

The Ethiopian Water Policy and Water proclamation clearly stipulate that all water resources (surface + Groundwater) are common property of the people of Ethiopia and the state. The necessary legal and institutional arrangements have continued to be established for this purpose.

GW 09: Asset Ownership defined

Definition for GWI 09: The legal protection of public and private properties invested in water infrastructures for whatever use in accordance with set rules, directives and procedures.

Asset ownership is adequately covered in the Ethiopian Water Resources Management Policy, proclamation and in the draft Regulation and moreover the Federal Constitution protects it.

GWI10: Number of issued water use permits and certificates of professional competence since the issuance of the water policy and water proclamation in 1999 and 2000 respectively.

Definition GWI10: Measuring the effectiveness of the water policy and the legislative framework already put in place by allowing people and competent organizations to be involved in development and management of water resources.

No permits or certificates or licenses have been issued to date. Not less than 250 applications for permits and licensing are known to have been submitted to their Ministry and are pending until the Regulation is approved by the council of Ministers, which of course, according to Ministry sources, is expected to be approved soon.

GWI 11: Effectiveness of legal treatment of water use priority

Definition for GWI 11: The extent to which water use priority is clearly defined by law, and the degree of its effectiveness on the allocation and apportionment of water resources in a situation where ' there are competing uses and users.

The highest priority is accorded to domestic water or safe water for human consumption to be followed by livestock.

(Federal Democratic Republic of Ethiopia, Water Proclamation article 7 sub-article 1)

2.3 Human Resources

GENERAL

Shortages of human resources in number and quality has been long identified as a critical problem by Government as well as by Water Sector Institutions as it hinders effective implementation of development plans.

Various means and ways have been employed to mitigate this problem at national and regional levels. Over seas training at master's degree level and short-term courses are to be mentioned. But this has not been found enough, Government therefore started expanding and upgrading available Colleges, Universities and Training Institutes capacitating them to them to increase their annual intakes. Compared to other sectors budget being allocated to the education sector is substantially high. This strategy has enabled Government since few years back to increase the number of people graduating from higher learning institutions. In addition, several private colleges and training institutions have also continued to be opened. However, human resources requirement of the Water Sector, which objectively needs trained and skilled multidisciplinary teams is not yet fulfilled.

Showing some few data on the manpower staffing of selected institutions, which are believed to represent the Federal institutions and the Regional Burezux, will concretize this reality.

2.3.1 Ministry's Human Resources Development Plan

The Ministry of Water Resources, with an effective involvement of Regions and due participation of various stakeholders has now developed Institutions/Capacity Building Programme as one key component of the 15-year Water Sector Development Programme, which was completed in 2002 after having been processed and studied for about three years.

The 15-year Institution/Capacity Building Programme therefore deals with a huge intervention in training plans ranging from tailored made to short-term and overseas training. It is planned that the required number and quality of human resources needed for the implementation of the 15-year Water Sector Development Programme (2002-2016) is to be fulfilled by implementing the capacity building programme.

Generally, the institution/Capacity Building Programme deals with institution building and strengthening, human resources development and community training programme, where thousands of community members will be trained.

Many engineers, economists, management staff, environmentalists, institution experts, professional and semi-professional personnel in the areas identified by the Federal Ministry and the Regional Water Burezux are included. (For detailed information please see the institution development programme with its annexes)

The total investment requirement for the programme stands at USD 218 Million over a 15-year period. Regional share constitutes about 89 percent of the total investment plan. About 43 percent of the plan requirements need to be met in the short-term planning horizon (2002-2006).

The remaining amount will be distributed almost equally during the medium (2007-2011) and the long-term (2012-2016) plans.

The plan for training is based on the assessment conducted along with the regional water Bureaux. They have identified their needs and as well the gaps.

The training needs and planned programme for the same are articulated in the manner that training outputs will be used for the implementation of water supply and sanitation programme, Irrigation, hydropower, water resources and the institution building and strengthening programmes that require a total investment cost of USD 7444.8 Million over the 15-year period.

The Ministry of Water Resources and the Regional Water Bureaux as part of their effort to implement planned institution/capacity building projects/programmes have been undertaking relevant measures of which the establishment of Vocational and Technical Training Programmes are to be mentioned here.

2.3.2 Groundwater Development and Water Supply and Sanitation Training Center

The process towards establishing this particular training center is known to have started in 1998. According to officials from the training center, effective training programme started in late 1999 with the technical assistance of JICA, Government of Japan and budget allocated from Federal Government.

Main objective of the training center is to build and strengthen human resources capacity of Regional Water Bureaux, which are currently too much constrained by lack of adequate number and quality of trained and experienced water professionals and technicians.

The necessary financial expenditures, materials and equipment are fully allocated from Government treasury. Ministry of Water Resources is responsible for budget preparations and for its subsequent approval by the concerned competent public authority, the council of Ministers and finally the council of peoples Representatives.

Expenditures including salary for teachers, accommodation for the trainees, facilities, equipment and other required materials for the training center are fully covered by the Federal Government with the technical assistance and cooperation of external donor agencies like JICA, Japan.

The table below would show the current focused areas of training, the background of the trainees in terms of their educational and training background and the duration of the training for each specified area.

The training Center has a regular programme and another non-regular / adhoc / supplementary programme according to sources from the center. Contents of each programme is demonstrated in two of the tables below.

Table 2.1: Regular Programme

No.	Training Areas	Education/Training background of trainees	Duration of the training
1	Groundwater investigation	Geologists	3 months
2	Drilling Technology	Drillers	3 months
3	Drilling Machinery	Maintenance Mechanics	3 months
4	Local Social Development	Community persons	2 months

Source: Ground Water Development and Water Supply Training Centers (2004)

Table 2.2: Non-Regular Programme

No.	Training Areas	Education/Training background of trainees	Duration of the training
1	Electric Maintenance	Electricians	1 month
2	Groundwater modelling	Geologists	1 month
3	Water supply services management	Water supply services management staff	1 month
4	Water supply Engineers	Engineers	1 month

Source: Ground Water Development and Water Supply Training Centers (2004)

The Training Center's capacity of its intakes is only 40 people per programme schedule, 3 months for the regular programme and 1 month for the non-regulation porogramme.

Training under the regular programme is undertaken twice a year. The total number of people to be trained annually under the regular programme is therefore not more than 80 people. All are drawn from the various regions in the country. Similar programme schedule is also undertaken under the non-regular or adhoc programme.

Since training was operational in 1999, a total of 600 people have been trained, all currently serving their respective regional water Bureaux. The outcome of the training and the impact it has brought about in terms of improvement in implementation capacity, preliminary assessments show that they are very helpful, according to sources from the Training Center.

In addition to the 600 trained Ethiopians, another 15 Africans from 13 African countries are known to have taken training for 3 weeks in 2004. According to sources from the training center and from the Ministry of Water Resources itself, ideas are being posed from stakeholders if there is a possibility of upgrading this training center to a level where it can serve other African countries.

2.3.3 Water Works Technical and Vocational Training Programme

This programme initially started in 2003 with 480 trainees in the six training centers that were simultaneously opened in four Regional States under the auspices of the Federal Government, the Ministry of Water Resources with effective collaboration secured from the Ministry of Education.

Each training center uses the same training curriculum as developed by the Ministry of Water Resources. It is a 3-year programme and after completion each training center awards a diploma for each successful trainee during his/her stay in his/her respective training institution.

Students admitted are those who have successfully finished or completed their pre-college/University education at senior secondary schools levels.

The main areas of training are in Irrigation, Water supply and Electromechanical, to be more specific courses are focusing on conducting studies, source investigation for water supply and irrigation, design, construction supervision and operation and maintenance. A course on rural sanitation is also given.

Two more training programmes/centers/ in the Regions of Afar and Somalia are due to be opened before the end of 2004 with a total intake of 200 and 150 persons respectively.

According to the Coordination Office for the Training Programme, currently only 411 diploma students are attending class in the six separate training centers. These are among those 480 who initially joined the training centers in 2003.

2.3.4 Other Institutions Contributing Professionals to the Water Sector

Most universities in the country are considering water and water-related courses in their respective university undergraduate and graduate programmes. Although the lacking of specialized training institute for the water sector is a clear indicator for the shortage of skilled manpower, there are few leading institutions that provide specialized courses and general training in various aspects of water resources. Of these institutions, the Arbaminch Water technology Institute, which was created in 1986, but now raised to a university level, has remained to be the only specialized Institute offering specialized training programmes such as Irrigation, Engineering, Hydraulics Engineering, Sanitary engineering etc. Since the past ten years or so it has started training civil Engineers, Electrical engineers and mechanical engineers in a limited number as this is associated to its current capacity.

Other than the Arbaminch University, there are also other universities giving water resources or related programmes at grauate and undergraduate levels, such as the following.

- Addis Ababa University (Civil Engineering and Electrical Engineering)
- Alemaya University (Irrigation, Agricultural Engineering)
- Mekele University (Dryland agriculture, hydrology)
- Bahir Dar University (Civil Engineering\, water resources engineering)
- Kotebe Electricity Training Center (Addis Ababa)

2.3.5 Current Manpower Staffing

It has been earlier mentioned that water sector institutions at Federal and Regional levels are not properly and adequately staffed with the right number and quality of trained and experienced staff. As there exists stiff competition in the labour market for experienced and skilled professionals, existing salary scales in the civil service and incentive schemes have failed to attract needed number and type of professionals to the water sector institutions. Many experienced civil engineers, economists, hydraulic engineers, irrigation engineers, and others of real importance are leaving the sector for better pay elsewhere in the country, mainly the NGOs, private sector and international organizations.

In order to demonstrate the above fact, the staffing status of the Ministry and one Regional Water Bureaux which both are assumed to represent realities in the rest of the regions is presented in the two tables below. This piece of information is believed to give a quick reflection of the extent to which work units in the water sector institutions are understaffed.

Table 2.3: Ministry of Water Resources Manpower Staffing

Professions by level of professions	Approved/Authorized position	Filled Position	Vacant Position	% Of filled position
Total positions	1237	826	411	66.77
Professional	334	202	132	60.48
Sub-professional	185	114	71	61.62
Supporting staff	718	510	208	71.03

Source: Ministry of Water Resources, Personnel Division, 2004

Table 2.4: Gambella Regional State - Water Mines and Energy Bureaux Manpower Staffing

	Profession	Approved position	Filled position	Vacant position	% of filled position
Regional Water Bureau	Professional Sub-professional Supporting staff	32 39 70	13 15 60	18 24 10	42 38 86
Zonal Office	Professional Sub professional Supporting staff	3 23 45	1 11 35	2 12 10	33 48 77
Gambella Town Water Supply Service	Professional Sub professional Supporting staf	- 16 17	- 10 17	- 6 -	- 62.5 100

Source: Gambella Water Bureau, 2004

N.B. The Region has two zones; a case of only one zone is here presented. The Gambella Regional State is one of those regions, which are said to be emerging (or regions with relatively low capacity)

2.3.6 Indicators

Challenge Area: Governing Water Wisely

Specific Aspect of the Challenge: Human Resources

GWI 12: Current Manpower Staffing Status

Definition of GWI 12: Looking at water institutions staffing conditions in terms of quality and number of the necessary human resources,

Water Sector institutions both public and private which are found at Federal and Regional levels are seriously constrained by shortage of the necessary manpower.

Two good examples to show the critical shortage of the human resources is shown below: the Ministry of Water Resources at the Federal level and the Gambella Region Water, Mines and Energy Bureau.

Table 2.5: Ministry of water Resources Manpower Staffing Status

No.	Positions by level of professions	Approved/Authorized positions	Filled Positions	Vacant Positions	% Of Filled Positions
1	Total positions	1234	826	411	66.77
2	Professionals (Degrees)	334	202	132	60.48
3	Sub-professionals (Diploma)	185	114	71	61.62
4	Supporting Staff	718	510	208	71.03

Source: Ministry of Water Resources, personnel section, 2004

The above table shows that work units in the Ministry are still understaffed, signifying that implementation capacity is constrained which objectively requires a quick measure to improve it.

Table 2.6: Gambella Regional State Water, Mines and Energy Bureau Manpower Staffing Situation

No.	Work places	Profession for the positions	Approved position	Filled position	Vacant position	% OF filled position
1	Regional Water Bureau	Professional (degree)	32	13	18	42
		Sub-professional	39	15	24	38
		Supporting Staff	70	60	10	86
2	Zonal Office	Professional	3	1	2	33
		Sub-professional	23	11	12	48
		Supporting Staff	45	35	10	77
3	Gambella Town Water Supply Service	Professional	-	-	-	-
		Sub-professional	16	10	6	62.5
		Supporting Staff	17	17	-	100

Source: Gambella Water, Mines and Energy Bureau, 2004

GWI 13: Number of Specialized Training Institutions

There is only one specialized higher learning institution, which came into existence since 1986 offering Water Programmes: degree level, diploma, Certificate and other tailored made courses. The Arbaminch University, which has been upgraded to university level in 2004 from its previous status, The Arbaminch Water Technology Institute has been the only specialized institute to train water professionals in the field of Irrigation, hydraulics, hydropower, water resources management, water supply and sanitation in degree programmes. This same institute has started Master programmes in three fields-Irrigation, Hydropower & Water Resources Management and hydraulics. There are about 4-5 Universities that offer engineering programmes that are useful in the water resources.

GWI 14: Number of Training Center of Water Programmes

There are 7 training centers responsible for training in various aspects of water resources. The Kality Ground Water Development and Water Supply and Sanitation Training Center and the other 6 Water Works Technical and Vocational Training Programmes.

The Kality training center has two programmes, a regular programme and a non-regular/adhoc/supplementary programme. Since its establishment in 1999 it has contributed to the Water Sector about 600-trained persons, trained in various fields ranging from one month to 3 months duration.

Table 2.7: Regular Programme

No.	Training Areas	Education/Training background of the trainees	Duration of the training
1	Groundwater investigation	Geologists	3 months
2	Drilling Technology	Drillers	3 months
3	Drilling Machinery	Maintenance Mechanics	3 months
4	Local Social Development	Community persons	2 months

Source: Groundwater Development and Water Supply Training Center

Table 2.8: Non-Regular Programme

No.	Training Areas	Education/Training background of the trainees	Duration of the training
1	Electric Maintenance	Electricians	1 month
2	Groundwater modelling	Geologists	1 month
3	Water Supply Services	Water Supply service management staff	1 month
4	Water Supply Engineers	Engineers	1 month

Source: Groundwater Development and Water Supply Training Center

The Water Works Technical and Vocational Training Programme, located currently at 6 different places are currently training 411 trainees of those 480 who were initially enrolled with the training centers. They have been raised from all regional states of the country. Currently as mentioned earlier, there are six Water Works Technical and Vocational Training Programmes located in four of the regional states. Other two are expected to be opened before the end of 2004 in Afar and Somali regions with an initial intake of 200 and 150 trainees respectively.

GWI 15: Incentive mechanisms

Incentive mechanisms in the civil service in general are found not attractive. As Government is the main responsible body for water resources development and management, motivational schemes for the water professionals such as Engineers, economists, Management, etc. are found to be very important. One incentive mentioned is the opportunity that young professionals get overseas training granted as scholarship by Government itself and through the financial support of donors. In terms of salary scale, it is still far behind the private sector and those international organizations working in the country.

2.4 Water Sector Programes, Goals/Targets

The Government of Ethiopia has developed a 15-year Water Sector Development Programme (2002-2016). Having fully realized that the inadequacy of supplying clean water to the population of the country is hampering improvements in various dimensions of social and economic developments, Ethiopia is genuinely considering supplying adequate clean water to improve the abject poverty condition of its people. It improves health condition and releases labour for productive engagement in the all-rounded social and economic activities, especially the women population who spend a lot of their time carrying water for domestic use.

Access to safe potable water in the year 2000 for urban areas was 72 per cent, and if Addis Ababa is excluded the figure becomes much worse, 38 percent, While the rural Ethiopia was about 23%. The country has utilized very insignificant amount of its potential runoff water, which is estimated 123 billion cubic meters and its groundwater potential of 2.6 billion cubic meters.

Moreover, the country's hydropower potential of 650 Twh per year and 3.7 million hectares of potentially irrigable land is almost untouched, only about 5% of the total irrigable potential is known to have been developed so far. Without considering the availability of both water and land at the desired time and place, studies show that something not less than 10 million ha. of land suitable for irrigation is available in the country. With the exception of Addis Ababa and possibly some other few urban centers, sanitation services/facilities is almost non-existent. It was therefore, for these underlying development and management reasons

that the Government of Ethiopia seriously embarked on a strategic planning framework, which called for the development of the Ethiopian Water Resources Management policy, the Ethiopian Water Sector Strategy, the 15-year Water Sector Development Programme (2002-2016) and the Poverty Reduction Strategy Programme (PRSP) better known as the Sustainable Development for Poverty Reduction Programme (SDPRP). And in addition as earlier discussed, under 1.2 of this paper, the issuance of the Ethiopian Water Resources Management Proclamation (FDRE 197/2000) and the Ethiopian Water Resources Management Regulation are to be mentioned.

The Water Sector Development Programme (WSDP) has been developed in support of implementating the fundamental principles and objectives of the Water Policy and the National Priorityes defined in the Ethiopian Water Sector Strategy.

The Water Sector Strategy for the Country covers all Sectoral Policies and Policy Matters on Cross-cutting issues. Without going in to describing each component issues of the strategy, Water Resources Development, Water Resources Management, Creating enabling Environment, Transboundary Waters, Financing, Stakeholders, Participation, Gender Mainstreaming, Disasters and Public Safety and Environmental health standards are the main ones.

2.4.1 Programme Components

The 15-year Water Sector Development Programme (WSDP) has the following five major components:

- Water Supply and Sewerage Programme
- Irrigation and Drainage Programme
- Hydropower Development Programme
- General Water Resources Programme
- Institutions/Capacity Building Programe

2.4.1.1 Water Supply and Sanitation Programme

The Water Supply and Sanitation Programme has set targets to be achieved over the 15-year programme period. Targets are therefore set for the national water coverage to be attained at the end of programme period in 2016, in the same manner target for the Urban Water Supply and Rural Ethiopia are also set. They are divided into 3-sub programmes divided into three - five rolling years consciously designed to maintain consistency with Government's Five year plans. The programme (WSDP) is therefore divided into short-term (2002-2006), Medium-term (2007-2011) and long-term (2012-2016).

The first three sub-sectors: Water Supply, Irrigation and hydropower are presented below in that order.

Table 2.9: National Water Supply Targets and Population to be Served Over the 15-Years Period

	2001			End of 2006 2002-2006			End of 2011 2007-2011			End of 2016 2012-2016		
National	Total Pop. ('000)	Coverage %	Total Pop.served ('000)	Total Pop. ('000)	Coverage %	Total Pop. to be served	Total pop. ('000)	Cover-age %	People to be served	Total pop. ('000)	Cover-age %	Total peoples to be served ('000)
	65,344	30.9	20,190	75,067	45.1	33,862	85,647	60.1	51,453	96,759	76.0	73,604

Source: Ministry of Water Resources, WSDP Main Report (2002)

At the end of the programme period (2016) national water supply coverage will hit a level of 76.0% from its 31% in the base year of the programme (2001).

The setting of the targets indicate that Government has made a conscious decision to meet its commitments for the Millennium Development Goals (MDGs). If set targets are achieved, the number of people without access to safe water will be only 24%, which is far less than half of the population. The total population of Ethiopia will reach 96,795,000 at the end of the programme period increasing by 31, 451,000 over the 15 years. At the end of the programme there will be only 22,991 Million people without access to safe water.

Table 2.10: Urban Areas Water Supply Targets and Number of Urban Dwellers to be Served

	2001			End of 2006			End of 2011			End of 2016		
National Urban	Total Pop. ('000)	Cover-age %	Total Popu. to be served	Total Pop. ('000)	Cover-age %	Total Pop. to be served ('000)	Total popu. ('000)	Cover-age %	People to be served	Total pop. ('000)	Cover-age %	Total peoples to be served ('000)
	9,886	74.4%	6,360	12,172	87.8	10,687	14,942	97.3	14,534	18,159	98.2	17,838

Source: Ministry of Water Resources, Water Sector Development Programme (WSDP).Main Report (2002)

- The targets set for sub-programme periods are 87.8% (end of 2006), 97.3% (end of 2011) and 98.2% (end of 2016). This shows urban water supply coverage will grow from what it was in 2001 (74.4%) to 98.2% at the end of the programme period (2016). Provided set targets are to be achieved, the plan that Government has committed itself is a good explanation how the Ethiopia water Sector Development Programme is consistent with targets set for the Millennium Development Goals.
- Programme outputs that are believed to achieve set targets for urban centers are planned as follows:-
  - Study and design for 391 towns in the country,
  - Construction of water supply services for 402 towns,
  - Rehabilitation works for existing supply services, 112 towns.

Table 2.11: Rural Water Supply Targets and the Number of People to be Served Over the 15-Year Period.

	2001			End of 2006			End of 2011			End of 2016		
National (Rural)	Total Pop. ('000)	Cover-age %	Total Pop. to be served ('000)	Total Pop. ('000)	Cover-age %	Total Pop. to be served ('000)	Total pop. ('000)	Cover-age %	People to be served	Total pop. ('000)	Cover-age %	Total people s to be served
	55,488	**23.1**	**12,820**	**62,895**	**36.8**	**23,175**	**70,705**	**52.2**	**36,916**	**78,636**	**70.9**	**55,765**

Source: Ministry of Water Resources, Water Sector Development Programme (WSDP) - Main Report (2002)

As the table above shows, rural water supply coverage will grow from what it was in 2001 (23%) to 71% by the end of the programme period (2016).

The programme output that would help to realize set targets are as follows (in absolute numbers)

- Deep wells 4255
- Shallow wells 9329
- Hand dug wells 27,337
- Spring development 18,908
- Sub-surface dams, surface water
- Harvesting, river intakes 222
- Rehabilitation of existing water supply schemes 2857
- Livestock watering schemes 10761

2.4.1.2 Planned Targets for Irrigation Development Programme

In terms of the number of projects for the plan period (2002-2016) 1568 are small-scale irrigation schemes with an average size of each scheme ranging from 70 to 90 ha. The total area in ha. to be developed is 127138. Developing these schemes will benefit up to 508,000-farm families.

26 large and medium-scale irrigation schemes are also considered in the programme. (Medium-scale schemes sizes are from 100-3000 ha and those above 3000 ha. are large schemes)

The large and medium-scale irrigation development programme output (147,470 ha) will benefit up to 300,000 farm families or provide employment for up to 30,000 permanent and 300,000 seasonal workers. The summary of National Irrigation Development targets is presented below.

Table 2 12: Planned Irrigation Targets (Ha.) Over the 15-Year Period

No.	Types of Projects	Area in ha.	% Of total planned Area to be irrigated	Total investments in MUS$)	% of Irrigation Development Investment
1	Small-scale irrigation (1568 schemes)	127,138	46.43	599.4	35.6
2	NILE BASIN Initiative Irrigation Projects	74,112	30.3	585.8	40.8
3	3 Suspended irrigation schemes	34,000	12.58	220.4	13.1
4	7 other Large and Medium scale irrigation Schemes	29,062	10.58	166.6	9.9
5	2 multi-purpose Schemes (studies)	124,626	-	10.2	0.6
	Total	274,612	100	1683.1	1000

Source: Ministry of Water Resources, Irrigation Development Programme Report 2002.

2.4.1.3 Hydropower Development Programme

In setting targets for the 15-year WSDP planning period, the hydropower development programme has targeted the needs of the Ethiopia people for energy from hydroelectric power. While setting future targets, three important demand considerations were taken into account.

- Local demand for electricity,\
- Export demand,
- Demand for small hydropower development in rural areas of the country.

A table for Electricity demand in the Hydropower Development Programme for the plan period (2002-2016) is presented below:

Table 2.13: Electricity Demand In MW

Targets/consume categories	(2001) Situation MW	End of 2006 (short-term) MW	End of 2011 (Medium-term) MW	End of 2016 (long-term) MW
. Domestic	441	636	857	1152
. Services	311	507	750	1124
. Industries	562	836	1163	1619
. Rural	-	24	70	145
Total	1314	2003	2840	4040

Source: Ministry of Water Resources, Hydropower Programme Report 2002.

A total of 6 medium hydropower plants with an aggregate installed capacity of 950 MW will be constructed. The study shows this will raise the total installed capacity of hydro plants in the ICS of the National Electric Company to about 1300 MW by the end of the programme period. A total of 15 medium hydro sites and 37 small hydro sites are to be studied to feasibility level during the programme period.

Accordingly, per capita generation of electricity will grow from what it was in 2000 (27 kwh/year) to 52KWh/year in 2016.

2.4.2 Cost and Financing of the Programme

The total investment requirement of the Ethiopia Water Sector Development programme (WSDP) is estimated to be 7444.8 MUSD, of which, according to the source document, US$ 3483.8 million is for federal projects and US$ 3961.0 million is for regional projects. The sub-sectoral allocations are shown as follows:

- Water supply & sewerage US$ 2935.1 million (39%)
- Irrigation US$ 1683.1 million (23%)
- Hydropower US$ 656.3 million (9%)
- Institutions US$ 218 million (3%)

Table 2.14: Summary of Investment Plan (US$ million) for the plan period (2002-2016)

Sub-sectors	Short-term 2002-2006	Medium-term 2007-2011	Long-term 2012-2016	Total 2002-2016	Share of Each programme
Water Supply & Sewerage	876.2	1,057.9	1,001.7	2,935.8	39%
Irrigation	307.9	456.9	918.3	1,683.1	23%
Hydropower	649.1	525.9	776.7	1,951.7	26%
General Water Resources	183.1	231.9	240.5	656.3	9%
Institution/capacity buildings	92.9	63.3	61.7	217.9	3%
Total	2110.0	2,335.9	2998.9	7,444.8	

Source: Ministry of Water Resources: WSDP, Main Report 2002.

2.4.3 Sources of Funding

The investment requirements for WSDP are assumed to come from three major sources of financing:

- External sources (grants, and loans)
- Domestic sources (Government treasures, domestic private sector, communities contributions)
- Private capital investment international

2.4.3.1 The Financial Plan

The study does not exactly show who would contribute what amount or what resources towards implementing the WSDP. Government's resource mobilization strategy is just to present this WSDP to various development partners and do everything possible for their participation in its implementation.

However based on past experiences of funding, especially from experience of the Health, Education and Road Sectors Development Programmes, the Government has made tentative estimates of financing from different sources.

Government Strategy is not to fully rely on the external funding, but to generate as much fund locally as possibly. However in view of the limited capacity of the Government in meeting all the required investment fund, USD 7444.8 Million from local sources, funding from external agencies is believed to constitute an important share towards achieving set programme objectives/targets.

As reported in the Water Sector Development Programme document (2002) Government mobilization of financial resources was able to do so about 60 per cent of the short-term funding requirement that amounted to US $1,241. Details are presented below.

- Hydropower Development (from the Nile Basin Initiative) USM$ 742
- Government allocation from treasury USM$ 325
- Contributions from beneficiaries of Small-scale Irrigation Development USM$ 19
- Contributions from beneficiaries of Rural Water Supply Development USM$ 55

- Funding that was already availed from bilateral and multilateral agencies USM$ 100
- Total USM$ 1241
- Net Requirement USM$ 869

How much of the net requirements have been secured between 2003 and 2004 is not assessed so far.

Table 2.15: Contribution of various financing sources to WSDP (per cent)

Sub-sectoral Description	Government (Federal and Regional)	Private Sector (international)	Private sector (Domestic)	Community/ Beneficiaries	Multi-laterial and bi-lateral agencies	Total
Water Supply and Sewerage						
Urban Water Supply	10	40	10	-	40	100
Rural Water Supply	40	-	-	10	40	100
Sanitation	10	40	10	-	40	100
Irrigation						
Small-scale irrigation projects	80	-	10	10	-	100
Medium & large project	10	-	20	10	60	100
Hydropower	-	80	20	-	-	100
Federal projects	50	-	50	-	-	100
Regional projects						
General Water Resources	25	-	-		75	100
Monitoring network	25	-	-		75	100
Flood protection works	75	-	-		25	100
Basin Master plan studies						
Institution and capacity building						
Human resource development	40	20	-	-	40	100
Institution building	70	-	-	-	30	100

Source: WSDP Main Report, Ministry of Water Resources

An exercise has been made to translate the percentages in the above table over the entire WSDP planning horizon in to absolute figures. Financial targets are set tentatively from different sources for the 15-years Programme.

- US$ 1,827 million from government sources (24.5%)
- US$ 1,895 million from international private sector (25.4%)
- US$ 759 million from domestic private sector (10.2%)
- US$ 377 from communities/beneficiaries (5.1%) and
- US$ 2,585 million from multi-lateral and bilateral donors (34.8%)

2.4.4 Water Sector Programme and Poverty Reduction Strategy Programme (PRSP).

For the purpose of PRSP, the first three years of the 15-year Water Programme (2002/03 - 2004/05) are considered. The programmes have their respective investment schedules,

implementation strategy, institutional and coordination arrangements, and monitoring and evaluation mechanisms.

2.4.4.1 Prsp Programme Targets

For the programme period 2002/03-2004/05 Irrigation Programme aims to develop a total of 29,043 hectors of new land, which would bring total irrigated land to date 226,293 ha. making 114,390 household beneficiaries. The small-scale irrigation schemes for the same programme period (2002/03-2004/05 is anticipated to cover an area equal to hectares 23,823 benefiting about 93,510 households.

Hydropower targets for the programme of the PRSP is set as a reconnaissance study of 5 sites, updating of reconnaissance at 3 sites, per feasibility of 1 site and feasibility study of 4 sites, all expected to significantly contribute to MDGs achievement.

General Water Resource's targets indicate, hydrology and sediment control of 90 stations of different class; establishment of 120 meteorology stations and 8 regional offices; conducting National Groundwater Assessment; flood protection studies complete and start up projects. Projects under the Nile Basin Imitative (NBI) and other programmes and integrated basin development Master plan studies, Complete already started projects and start up projects.

- The targets under the Institution/Capacity Building are mainly to strengthen and build new institutions, which include among others, the following:
- Basin Development Institutions
- Water Sector Information Center
- Water Research Center and
- Water Resources Training Institutions

With the Institution Programme there is a target set to train 210 staff at the Federal and 301,488 at regional levels which include Community training i.e. out of the regional trainees about 284,591 are members of the communities while the remaining are to be selected for Woreda (local level), Zonal water departments and Regional Water Bureaux.

Table 2.16: Programme Cost and Financing (in million Birr)

No.	Programme/Activity	2002/03	2003/04	2004/05	Total
1	Water supply and sanitation	910.9	1,237.2	1,414.6	3,562.7
2	Irrigation and Drainage	486.9	756.1	760.9	2,003.8
3	Hydropower study and design	9.4	39.2	61.8	110.4
4	Basin development studies	35.9	42.9	50.8	129.6
5	Water resources data base/assessment	33.5	31.5	32.7	97.8
6	Water resources management	87.3	103.6	197.3	370.2
7	Capacity building & general service	46.6	179.2	214.6	440.5
8	Meteorology	23.0	32.6	41.6	97.2
9	Transboundary waters	0.7	0.9	1.1	2.7
Total		1,634.2	2,423.3	2,757.5	6,814.9

Source: Ministry of Water Resources prepared for SDPRP and reported in the key sector development policies and strategies by Ministry of Finance and Economic Development (2003).

N.B. The Birr is the National Currency of Ethiopia

1USD = 8.6319

2.4.5 Programme Implementation Arrangementsand Strategies

The water sector development programme(WSDP) is a national water plan genuinely addressed to all stakeholders for their concerted actions. Stakeholders including public, private sector, NGOs, international development partners and communities are believed to be forces of action for the implementation of the programme. To this end, the WSDP study has finally articulated main elements of its implementation strategy.

2.4.5.1 Elements of the Implementation Strategies

- Capitalize and build upon existing government institutional structures without necessarily waiting for new institutional set-ups. New institutions are to be established as appropriate and required due course of the implementation process.
- Coordination and integrating programme components during implementation by realizing the specificities of each programme.
- Tailor the programme implementation in order to cope up with financial resource requirements i.e. consideration of different funding scenarios .
- Priorities are given to ongoing and start-up projects/ programmes, most of such projects are included in the short-term programme period of (2002-2006) WSDP.
- Continuous resource mobilization efforts ate taken as key implementation strategy
- Decentralized management of programme implementation of all programme components.This will be done according to the outcome of the ongoing preparation of Programme Implementation Manual(PIM), a manual for WSDP implementation is being prepared using the competence of a national consulting agency.
- Innovative partnership is to be promoted and created among stakeholders.
- Reliance on national expertise is to be pursued, but securing external technical assistance will not be overlooked.
- Continuous adjustment of the programme is another strategy, which is to be based on prgramme implementation performance using monitoring indicators that are to be outlined in the PIM. The necessary adjustments possibly to make are related to financial, technical and institutional issues.

2.4.5.2 Implementation Arrangements and Roles of Stakeholders

Government Institutions

The Federal Ministry of Water Resources and Regional Water Bureaux are to have a lead role during implementation of the programme. Other Federal and regional institutions are also expected to have a significant role. High profile decisions and policy reviews and issues concerning large investment projects are among the most important functions of the MOWR along with its partnering Federal institutions. Other functions are also inter-institutional collaboration and enhancing departmental and regional implementation capacities. Regional level Water Sector Bureaux and other relevant sector bureaux are assisting and coordinating activities of local level water desks, which are responsible for planning, budget preparation and implementing planned projects and activities. All stakeholders will be provided with the Programme Implementation Manual, once it is finalized and is ready for use.

Private Sector

Currently the private sector's role is not as such that strong. However, Government has continued to move forward in bringing on board private sector agencies to be involved in the all- rounded development of the Ethiopian water sector; the pace at which the private sector is moving towards its effective participation is at its rudimentary stage calling for a concerted government effort to encourage them using various types of incentive mechanisms.

Incentives mentioned in the WSDP documents are fiscal incentives in the form of tax holidays, access to land and water, concessional lending from commercial banks institutions, enhancing their technical capacities and management capabilities. The private sector on its part is expected to establish more efficient markets and bringing new investments to the sector.

In the spirit of public-private partnership, the private sector is seen as service provider, while in the context of Ethiopia, resource ownership like land and water are of the state and the general public.

Communities

Communities are expected to invest in the form of capita and labour as the case may be for some of the projects and programmes that are covered in the WSDP document. Consistent to the ongoing decentralization process in the country, communities and local level or commonly known as Woredas,the smallest government administrative unit for planning,budgeting and implementation are responsible bodies. Water Users Association and other Water Committees and Water Boards are good example of communities that are very close to all Community based Organizations.

Non-Governmental and External Support Agencies:

Number of NGOs working in Ethiopia according to certain sources is not anything more than 100 to 120, comparing to neighboring countries like Kenya they are extremely small in number. However, their involvement in water resources development will continue to be very important. NGOs are generally involved in project identification, implementation and financing. Areas of the interventions include among others, rural water supply and sanitation development, irrigation and other water related and poverty reduction and health improving projects. They are also expected to bring or mobilize more financial resources for WSDP implementation. NGOs are also involved in strengthening technical capacities of Regions and Localities; organize local communities and undertaking rehabilitation works.

In like manner the role of the International Support Agencies such as the Bilateral and Multilateral Agencies as they have committed themselves during WSDP preparation process will be mainly resource mobilization in the from of financial and technical assistance. To this end, the WSDP provides lending agencies and domors a ccomprehensive framework not only to select projects/programmes for financing in accordance with their respective country financing strategies, but also to coordinate water sector activities in order to improve the efficiency and management of external assistance and loans.

Organs that are proposed to be established towards implementing WSDP using the implementation Arrangement are the following:

- An Inter-Ministerial Steering Group
- Federal Programme Management Unit (FPMU)

- Regional Programme Management Unit (RPMU)
- Sub-programme level Teams under the FPMUs and RPMUs.

2.4.6 Monitoring and Evaluation of the Sector Programme

Similar to many other national projects and programmes, the responsibility of monitoring and evaluation tasks are of the Government, which is part of its main responsibilities to execute its own projects/programmes. The ongoing exercise to prepare the Programme Implementation Manual (PIM) for WSDP is going to come up with operational plans modalities, performance indicators, monitoring tools and as the document puts it, boundary conditions. Accordingly, continuous monitoring of performance indicators for various projects planned under different programme components will be conducted. Secondly, intensive review and evaluation of programme performance on some agreed basis would be done. Thirdly, annual review programme performance by the Steering Group will be carried out.

It is however very important to note here that the programme implementation arrangement proposed in this 15-Water Sector Development Programme is not yet put in place.Implementation of projects/programmes included in the programme are known to have continued without the proposed arrangement.

2.4.7 Indicators

Challenge Area: Governing Water Wisely (Water Governance)
Special Aspect of the Challenge: Water Programme Goals/Targets
GWI 16: Water Sector Programmes Development and Targets Set.

Definition of GWI 16: The availability of national water sector planning framework under which sector planning is addressed in a comprehensive and integrated manner by including the major sub-sectors to the programme and achievable target are set over the programme period.

A 15-year Water Sector Development Programme has been developed and put in place since 2002. The Sector Programme is composed of five main sub-sectors namely: water supply and sanitation, irrigation, hydropower, general water resources and institution/capacity building. The planned targets for sub-sectors under the three sub-programme periods 2002-2006, 2007-2011, and 2012-2016 are set as shown below.

Table 2.17: Water Supply Targets/Goals

Sub-Sectors	Base year 2001	Short-term 2002-2006	Medium-term 2007-2011	Long-term 2012-2016
National targets	31%	45.1%	60.%	76%
Urban	74.4%	87.8	97.3%	98.2%
Rural	23.1%	36.8%	52.2%	71%

Table 2.18: Planned Irrigation Development Targets/Goals.

Sub-Sectors	2001	Short-term 2002-2006	Medium-term 2007-2011	Long-term 2012-2016	Total 2002-2016
Irrigation (ha.) Small-scale	98,6252	40,319 ha	40,348 ha	46,471	127,138
Large and Medium scale	98,625	13,044 ha	39,701 ha	94,729	147,474
Grand Total	197,250 ha	53,363 ha.	80,040 ha	141,200	274,512

Source: Water Sector Development Programme (WSDP), Ministry of Water Resources.2002

Table 2.19: Planned Hydropower Development Programme Targets/Goals

Consumer categories	Base year 2001 in MW	End of 2006 Short-term MW	End of 2011 Medium-sterm MW	End of 2016 Lont-term
Domestic	441	6363	857	1152
Services	311	507	750	1124
Industries	562	836	1163	1619
Rural	-	24	70	145
Total	1314	2003	2840	4040

Source: Ministry of Water Resources, Hydropower Sector Programmes, 2002

Water Resources Development Programme Targets/Goals

At the end of the programme period in 2016, all rivers basins in the country will be studied at Master Plan levels. Watershed Management, flood control and water quality monitoring are other areas of interest to be carried out. Some of the studies have started now, especially watershed management projects under the Nile Basin Initiative. A total of 274-river flow measuring stations and 745 meteorological stations will be established.

GWI 17: Programme cost and Financing estimates and arrangements defined.

Definition of GW15: Investment cost estimates for each of the sub-programmes and a total investment cost estimate of WSDP is defined/known and the modalities of its financing is also defined by way of identifying the participating stakeholders and shares/contributions expected.

Table 2.20: Summary of Cost and Financing USD Million

Sub-Sectors	Short-term 2002-2006	Medium-term 2007-2011	Long-term 2012-2016	Total 2002-2016	Share of each programme
Water Supply and Sewerage	876.2	1,057.9	1,001.7	2935.9	39%
Irrigation	307.9	456.9	918.3	1683.1	23%
Hydropower	649.1	525.9	776.7	1,951.7	26%
General Water Resources	183.1	231.9	240.5	656.3	9%
Institution/Capacity Building	92.9	63.3	61.7	217.9	3%
Total	2110.0	2,335.9	2998.9	7444.8	100%

Table 2.21: Planned Stakeholders Investment Distribution/Shares 2002-2016

Stakeholders	Amount (USD million)	Per cent age shares
Government	1827	24.5%
Domestic private sector	759	10.2%
International private sector	1895	25.4%
Bilateral and Multilateral Agencies	2585	34.8%
Communities/Beneficiaries	377	5.1%
Total	7444.8	100

Of the Short-term investment requirement, which is USD 2110 million, it has been assessed that USD 1.241 billion have been secured from Government sources, bilateral and multilateral agencies, including from the Nile Basin Initiative (NBI) and assumed community contribution.

2.5 Financial Resources

Budget allocated for water and water related activities are treated here below, but as to the future investments they are adequately treated under section 1.4 for programmes /Goal/targets specifically under financial plans below, again they are reflected here for completeness sake of this part.

2.5.1 Budget Allocated for Water Related Investment

In this section an attempt would be made to present budget allocated and utilized by source of finance in two sets of planning periods of the Government of Ethiopia.

Table 2.22: Budget Allocation and utilization by source of finance 1992-1998 (inclusive) '000 Birr

Sub-sectors	Budget allocated				Budget utilized			
	Gov't	Grant	Loan	Total	Gov't	Grant	Loan	Total
Water supply	1251348.7	434571.1	348083.84	2034003.6	1062032.8	92401.77	152558.2	1306992.73
Urban	1251348.7	131993.2	348083.84	173425.7	926353.7	63887.67	152558.2	942799.57
Rural		302577.9	0	302577.9	335679.06	28514.1	0	364193.16
Irrigation	548434.1	18623.6	77734.2	644791.9	344805.01	9083.29	34591	388479.3
Medium and large	207077.3	18623.6	77734.2	303435.1	165250.57	9083.29	34591	208924.86
Small scale	341356.8	0	0	341356.8	179554.44	0	0	179554.44
Basin Development	122515.2	34000	0	156515.2	110929.2	34000	0	144929.2
Hydropower	72703	5705	0	78408	62626.8	3395	0	66021.8
Meteorology	160026.81	3575	0	19601.81	12581.45	0	0	12581.45
Hydrology	9780	4928	0	14708	5372.85	31642	0	37014.85
GRAND TOTAL	2020807.81 (68.55%)	501402.7 17.00%)	425818.04 (14.45%)	2948028.6 (100%)	1598348.1	170522.1	187149.2	1956019.33
Rate of Utilization					79%	34%	44%	66%

Source: Ministry of Water Resources, Planning and Projects Development

Table 2.23: Budget Allocation and Utilization by source of finance 1999-2002 (inclusive)

Sub-sectors	Budget allocated				Budget utilized			
	Gov't	Grant	Loan	Total	Gov't	Grant	Loan	Total
Water supply	15241.07	0	197144.5	212385.57	16145.55	0	90607.07	106752.62
Urban	15241.07	0	197144.5	212385.57	16145.55	0	90607.07	106752.62
Rural	0	0	0	0	0	0	0	0
Irrigation	17560.46	111460.1	196456.1	325476.66	23068.39	423	36366.4	59857.79
Medium and large	4618.5	0	3243	7861.5	3686	0	0	3686
Small scale	12941.96	111460.1	193213.1	317615.16	19382.39	423	36366.4	46171.79
Basin Development	9481.9	0	0	9481.9	7917.24	0	0	7917.28
Hydropower	17164.56	14955.5	0	32120.06	3857.23	8885.05	0	12742.28
Water Resources	14210.73	0	0	14210.73	3881.81	0	0	3881.81
Meteorology	38475.81	24229.8	0	62705.61	42633.62	2919.65	0	45553.27
Hydrology	2720.2	9055.1	0	11775.3	1379.3	2159.9	0	3539.20
Capacity Building	23128.62	123695.5	0	146824.12	14730.75	81320.64	0	96051.39
GRAND TOTAL	137983.35 (16.93%)	283396 (34.77%)	393600 (48.30%)	814979.95 100%	113613.89	95708.24	126973.47	336295.6
Rate of Utilization					82%	34%	32%	41%

Source: Same as table above

The above two tables easily demonstrate that budget allocation for the water sector concerns all types of interventions for the development and management of water resources. There is no major water resources sub-sector that has not called for budget

allocations in the two sets of planning periods as presented above, (1992-1998 and 1991-2002) where 1998 and 2002 of the two periods are inclusive in the budget allocations.

The fact that a major part of the budget was allocated for water supply, both for urban and rural showed that a high priority is given to improve the social and economic lots of the population by giving away problems that people are confronted with lack of access to adequate and safe water supply services, followed by the investment in irrigation for meeting food security and food self sufficiency requirements.

The budgetary allocations for basin development, hydropower, meteorology, hydrology and capacity building clearly show that comprehensiveness and integrated approach towards water resources development and management is a condition without which an integrated planning framework can be realized.

In the periods 1992-1998 Government's contribution to the investment allocated for the various water resources activities is significantly high (68.55%) compared to the budget allocated from the other two sources, 17.00% and 14.45% from grants and loans respectively.

For the periods of 1999-2002 Government's share to the total investment has shown a sharp decline down to 16.93% of the total budget allocated for this same period. But relatively the share from grants and loans 34.77% and 48.30% respectively were higher from what government invested.

Again the source of financing showed that government without an effective and genuine support of donors would be in a problem to address development and management needs of the water sector, which usually requires substantially higher capital investment.

In 2002/2003 fiscal years, the MoWR's total budget allocation was equal to Birr 1438856.1 (432799.85, 419870.4, 586108.6 from Government, Grant and Loan respectively (figures are in '000) utilization rate was 77.34%, 33.7% and 40.9% in the same order). Aggregate utilization rate was only 49.75%, while total budget allocated for 2003/2004 was Birr 521,069,200 and Birr 27,329,2000 for capital and recurrent budgets respectively.

Regarding the rate of utilization, the performance of government budget or fund utilization had been always good and better high compared to those from grants and loans, this is probably due to procedures of donors that do not allow quick release of funds coupled with the lengthy procurement procedures of the same.

2.5.2 Future Investment by Source

Although data should be further assessed as to how much of the investment requirement in the short-term has been secured between 2003-2004, the future investment requirement for the Water sector development Programme as shared or distributed among the main stakeholders is shown below, both in absolute figures and percentage terms.

Government	USD Million	1827 (24.5%)
Domestic private sector	USD Million	759 (!0/2%)
Private sector (international)	USD Million	1895 (25.4%)
Bilateral and Multilateral donors	USD Million	2585 (34.8%)
Communities/beneficiaries	USD Million	377 (5.1%)

2.5.3 Indicators

Challenge Area: **Governing Water Wisely (Water Governance)**

Specific Area of the Challenge: **Financial Resources**

GWI 18: Amount invested in water and water related investments

Definition of GWI 18: Assessing how much of the country's investible fund from all sources

have been channeled to water resources investment plans in two specified plan periods of the GOE.

In 1992-1998 a total of Birr 1251.35 Million, 0.434571100 million and 0.348083840 Million from Government, grants and loans respectively had been invested for water supply projects. In the same time period Birr 0.5484341 Million, 0.0186236 Million and 0.0777342 Million from Government, grants and loans respectively was channeled to irrigation sector. For Basin Development an amount of Birr 0.1225152 Million from Government and 0.034 Million from grants had been invested. Taking Hydropower, Meteorology and hydrology together a total investment of Birr 0.24250981 and Birr 0.014208 respectively from government and grant had been invested.

Therefore, a total of Birr 2.02080781 Million, Birr 0.5014027 Million and Birr 0.42581804 million was channeled to Water and water related activities from Government, grant and loans respectively.

GWI19: Rate of Utilization for the same period:

79%. 34% and 44% for Government budget, grant and loans respectively and an aggregate or a total rate of 66% Financial Utilization has been assessed.

GWI20: Budget allocated for 1999-2002

For the period 1999-2002 a total of Birr 0.01524107 Million, and 1.971445 Million from Government and loans respectively had been invested for water supply projects.

For irrigation in the same period Birr 0.01756046 Million, Birr 0.1114601 Million and Birr 0.1964561 Million from Government, grant and loans respectively was channeled. For Basin Development during this period only 0.0094819 was invested from Government sources.

For Hydropower, water resources, Meteorology, hydrology and capacity building put together a total of Birr 0.09569992 Million, Birr 0.1719359 Million and Birr 0.26763582 million respectively from Government, grant and loans had been allocated.

GWI21: Rate of Utilization for the same period:

82%, 34%, 32% from Government allocated funds, Grants and loans respectively were utilized. The total financial performance in terms of utilization all the three different sources taken together was only 41%, which is lower than the previous years treated above.

Exchange rate of 1 USD = 8.6319 Birr

2.6 Management Approaches

As far as management of Urban Water Supply Services is concerned they are autonomous to plan, implement, and manage their respective water utilities or services. In most of the big towns and cities in the country they are organized or institutionalized by law as Water Supply Agencies responsible to provide urban dwellers with adequate and safe water as conditions permit. Consistent to Government's Water Policy and associated laws and regulatory frameworks, each urban water supply service has the full right to devise its own ways and means to satisfy the needs of the people, including demand management, which is a tool during shortage of supply and in cases where there are abuses of use of the water available. There are also water boards and water committees fulfilling such responsibilities in and around small towns or in a village type settlements.

In the case of the rural setting, there are water committees in most of the cases and in certain areas Water Boards that are responsible for managing the schemes by way of contributing funds for maintenance and operation and wherever possible for replacements. By policy and law, investments for rural water supply and sanitation schemes are from block grants. According to the Ethiopian Water Policy tariffs are site/project specific and accordingly, concerned water committees or water boards with an effective consultation of their constituents set tariffs for the services that each scheme is deemed to provide.

2.6.1 Demand Management

Demand management is known to be one of the tools that is being applied in situations where things require to do so.

Progressive tariffs (price) are used in big towns and cities, where the higher the consumption is, the higher would be the price to pay. So, the rates are strongly linked with level of consumption. The less you consume, the less you pay and the higher the consumption the higher becomes the rate. But, the water policy states that tariffs should neither be low leading to abuse of its use nor should it be higher to discourage consumption. It is however clear that water tariffs/prices are here being used to manage demand in order to ensure efficiency and effectiveness of water use.

Rationing of water in cases where there is shortage or scarcity of the safe water is another possible scenario being used in Ethiopia as a reflection to water demand management. Supply of water be it public tap, yard connection or house connections could be on a morning or afternoon basis or it could be in round-turns, like once in every three days or less or more, depending on the magnitude of the problem of shortages of supply or other associated problems. This is also practiced in Addis Ababa, the capital city itself.

2.6.2 Stakeholders Participation

In Ethiopia stakeholder participation is welcomed by policy and law. NGOs, both local and international, are participating in the provision of clean water to many rural communities, and they also give their support in strengthening irrigation Water User Associations capacity. The number of local and international NGOs engaged in water related support are believed not to be a little more than 120 or so. The participation of stakeholders like the NGOs, the Multilateral Agencies like UNICEF, UNDP, WHO, EU etc. are playing a good role to meet water demands of communities and strengthening their capacity to plan, implement and manage projects and programmes. There are also bilateral donors who are extending their support either in the from of budgetary support to government or directly financing specific regional or federal projects of their interests.

In the section under 1.5 for budget allocation, the amount secured over those years from stakeholder in the form of grants and concessionary loans from the World Bank and African Development Bank and others have been very useful. Their participation had been very instrumental in improving the status of water supply provisions in the urban centers and as well in the rural areas.

2.6.3 Indicators

Challenge Are: Governing Water wisely (Water Governance)

Specific area of the Challenge: Management Approaches

GWI22: Demand Management tools

Definition of GWI21: What tools are used in the country to manage demand in supplying water to users.

In order to control water use from abuse in whatever form it is, progressive tariffs or prices are used. Tariff rates are strictly linked with consumption rates. The higher the consumption, the higher is the amount to be paid. Another aspect of demand management in situation where there are shortages of supply is rationing. Water Supply Services are forced to supply water to users in- turns, depending on the status of water availability in the locality in question. In addition to this, big enterprise, factories that consume significant amount of water are encouraged to develop their own sources. If we take rationing and quota are different things, then this study couldn't really verify whether water supply utilities or services use quotas in the provision of water to their clients.

2.7 Policy Implementation

Introduction

Water Resources Management Policy was issued by the Federal Government in September 1999.

The Ethiopian Water Resources Management Policy has a primary goal to promote efforts towards efficient, effective, equitable and optimum utilization of the available water resources.

The policy has also defined its general objectives and principles. The overall objective of the policy is to enhance the well-being and productivity of the people through sustainable development of water resources for equitable social and economic benefits.

The water policy has two main components.

1) Sectoral policies - Water Supply and sanitation policy, Irrigation policy and Hydropower Policy.
2) Policies on cross-cutting issues: which include among others, Water allocation and apportionment, watershed management, water conservation and protection, technology and Engineering, finance and economics, transboundary waters, water resources management information systems, stakeholders participation, water quality, disaster, emergency and public safety, R & D etc.

The Federal Government has issued in this policy the fundamental principles under which the integrated and comprehensive Water Resources Management is to be treated.

The Fundamental Principles that guide the equitable, sustainable and efficient and effective development and management of water resources are briefly listed below:

- Water is a naturally endowed commonly owned property of the people and the state.
- As conditions permit, citizens shall have access to safe water for basic human needs.
- Water is recognized as a social and Economic good in order to contribute significantly to sustainable social and economic development.
- Water Resources Management shall ensure social equity and economic efficiency, systems reliability and sustainability norms.
- Water Resources Management is decentralized and as well is rural centered and participatory.
- Promotion of participation of all relevant stakeholders, particularly women's participation in all endeavors of water resources development and management

Accordingly, the strength and merit of the water policy in Ethiopia is that it was developed along with concepts and Integrated Water Resources Management (IWRM) principles. The contents of the policy suggest that it is comprehensive and integrated approach that guarantee sustainability, provided the policy is effectively implemented at all levels by all concerned.

2.7.1 Implementation Progress

Lack of policy awareness and limited knowledge and information about the policy at various levels-public, private, and other stakeholders suggests that the competent public authorities like the Ministry, the regional water bureaux, and all other stakeholders have not undertaken adequate promotional and awareness raising activities.

No document or information that has assessed the performance of the policy is available. It is not clear which/what aspects of the policy are fully implemented and which ones are not and for what reasons. There is a gap in following up the real performance of the policy among which Monitoring and Evaluation system (M & E) is not yet put in place for this purpose.

It should, however, be recognized that the Federal Ministry has been taking several important reform measures towards implementing the policy. Among which the following are the most important ones.

- Ethiopian Water Sector Strategy has been prepared and officially put in place in 2001 to be used as a "road map" to translate the policy into action.
- A 15-year Water Sector Development Programme (WSDP) was completed and implementation started in 2002.
- A Water Resources Management Proclamation was issued by the Council of Peoples Representatives in 2002 (FDRE 1997/2000) to give the necessary legal ground for the implementation of the Water policy.
- A Regulation has been drafted by the Ministry and is currently with the council of Ministers for approval. The Regulation is the legal instrument by which the above-mentioned proclamations are to be implemented. In the absence of the regulation the proclamation has not been able to put it into use since 2000. With regard to some

aspects of the policy and the water law, such as water use permit and licensing, the Ministry is to start soon operating such things on a temporary basis.

- To solve some of the sector's capacity problems, Ministry of Water in collaboration with other stakeholders such as Ministry of Education has established Vocational and Technical Training centers at different locations of the four Regional States. Trainees are technicians for irrigation development schemes and water supply and sanitation services. These centers were operational since 2003.
- Establishment of the Kaliti Groundwater Development and Water Supply & Sanitation Training Center. It has been established with the technical assistance of the Government of Japan.
- As Establishing of a Management Information System is one policy provision, Ministry has now created a Data and Information and GIS Center for acquisition and dissemination of necessary data and information.
- National Water Supply and Sanitation Master Plan was also prepared with technical and financial assistance of the Dutch Government, the process was completed in 2003.
- Research and Development (R&D) is another item that the Water Policy emphasized. Accordingly, the Ministry has been able to create or establish a Department for Research and Development as one of its several departments. An attempt is also going on to establish Ethiopian Water Resources Research and Development Center (EWRRDC).
- Using the policy provisions, water professionals have alsonow opportuned themselves to create the Ethiopian Water Resources Association (2004).
- Ethiopia's active involvement in the Nile Basin Initiative and its significant contributions to the advancement of the Basin Cooperative framework in general is one area that water policy has effectively enhanced the efforts towards permanent and lasting legal and institutional arrangements.
- Cost-recovery principles for irrigation development and water supply services is now under some sort of start with the establishment of the Water Resources Development Fund office (WRDF) for this purpose (2003).

2.7.2 Indicators

Challenge Area: Governing Water Wisely/Water Governance/

Specific Aspect of the challenge Area: Policy Implementation

GWI23: Existence of National Water Policy

Definition for GWI23: This is just to check whether there is a nationally endorsed water policy for the country by which it can manage and develop sustainably the water resources of the country.

National Water Policy has been effectively put in place since September 1999. The Policy has three sectoral policies- Water Supply and Sanitation, Irrigation and hydropower. The policy also include policies on cross-cutting issues. Many policy issues have been also implemented in terms of putting in to effect the necessary legal and institutional developments and capacity building efforts etc.

GWI24: IWRM principles defined and implemented

Definition for GWI24: Articulations of IWRM principles as they are consistent to concepts and principles of IWRM worldwide. Implementation process is the extent to which these principles are applied or used in the all-rounded Water resources development and management in the country.

IWRM principles in Ethiopia are developed and articulated to serve as guiding principles for sustainability, equity and efficiency. They are presented in the water policy as follows:

1) Water is a commonly owned public property of the people and the state;
2) Every citizen has the right to have access to safe water for basic human needs as conditions permit;
3) Water is recognized as a social and economic good;
4) Water resources management is decentralized and participatory. Moreover it is rural centered;
5) Water Resources Development and Management shall ensure Social equity and economic efficiency and sustainability norms; and
6) Participation of stakeholders, particularly women's participation should be promoted in water resources development and management.

GWI25: Water Sector Strategy Developed

Definition for GWI25: It is rather putting in place an appropriate vehicle or guiding instrument or framework to translate the policy principles, goal and objectives in to action. It is road mapping towards the implementation of the policy by availing stakeholders with a general framework of policy implementation.

The Ethiopian Water Sector Strategy has been developed and effectively put in place for public use since November 2001. Contents of the Strategy are those elements included in the Ethiopian Water Resources Management Policy, but they are articulated in such a way that they give the best options to implement policy goal, objectives, principles and issued policy statements.

GWI26: PROGRESS OF POLICY IMPLEMENTATION

Definition for GWI26: Identifying problems and constraints of policy implementation, and know what aspects of the policy have been implemented efficiently and effectively.

Government or to be specific the competent public authorities for policy implementation including the Ministry of water Resources and regional water Bureaux have been undertaking reform measures which are believed to enhance the implementation of the policy on the ground. (see the following table 2.22)

Table 2:22

No.	Policy issues	Actions untaken on the basis of the policy
1	Awareness raising and promotional activities	. No adequate and systematic and significant awareness creation and promotional activities undertaken
2	Financing	. Water Resources Development Fund established in 2003 and Cost-recovery principles implementation started in some kind of its form, but not yet effectively operational.
3	Legal Issues	. Water Resources Management Proclamation issued by the Council of Peoples Representatives in 2000 (FDRE 197/200) Regulations for implementation of the proclamation drafted and submitted to council of Ministers for approval.
4	Water Resources Management Information Systems	Ministry has now created Data and Information and GIS Center
5	Capacity Building and Institutional Strengthening	. Groundwater Development and Water Supply & Sanitation Training Center established in 1999 with the Technical assistance of the Japanese Government. . Vocational and Technical training programmes established for technicians or sub-professionals in irrigation development and water supply and sanitation schemes. Six training centers in total are now opened in different locations of the four regional states. (Tigray, Amhara, Oromia and SNNPR) . Under graduate programmes for water specific needs and post-graduate programme in irrigation, hydraulics and hydropower, Civil Engineering Electrical, Mechanical Engineering in the former Arbaninch Water Technology Institute, now the Arbaminch university (2004) are offered.
6	Transboundary Waters	Government has continued to make significant contributions towards the Nile Basin Initiative arrangements for a permanent and listing legal and institutional arrangement among the riparian states of the Nile River.
7	Creation of Basin Institutions	. Government has now embarked on the creation of Basin Institutions statics for the Abbay Basin, widely known by others as the Blue Nile. An institutional study is currently on going with the financial and technical assistance of the Government of the French Republic. Once successful with the establishment of the institution for the Abbay Basin, it is planned similar institutions will be created for the rest of the Ethiopian Water basins in subsequent phases.
8	Water Quality Monitoring	. Ministry of Water Resources has developed and issued a National Guideline for drinking water supply.
9	Development plans	. A 15-year Water Sector Development Programme (2002-2016) has been developed and put in place for implementation since 2002. The sector plan is meant to implement the policy on the ground.

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Chapter 3

3 Water Resources of the Country

3.1 Background on Water Resources Development

Surface water resources are available though their spatial and temporal distribution and settlement pattern of the population limits their utilization. The mean annual specific runoff varies from zero to 35 l/s per km2. Minimum flows occur in the period from December to March. Apart from the big rivers and their major tributaries, there is hardly any perennial flow in areas below 1500m. In general, perennial streams and springs exist only in the vicinity of mountains with an annual rainfall of more than 1000mm.

The country's annual renewable fresh water resources amount to some 122 BCM/yr in the twelve river basins. However, only 3% remains in the country. The rest, 97% is lost in run-off to the lowlands of neighboring countries. Based on a population of 68 million in 2003, the per capita share of water is 1794 m3/year. This will make the country on the threshold of being classified under water stress. At this stage of water development, where the country withdraws less than 5% of its fresh water resources for consumptive uses, classification under water stress, may not be so relevant.

The rivers are characterized by irregular regimes and their natural flows cannot be taken as assured available supplies. The average annual precipitation, surface runoff, and evaporation vary gently geographically.

The total safe yield of groundwater was estimated to 26.1 BCM. It is estimated that 54.4 BCM of surface runoff and 2.6 BCM of ground water could be technically developed for consumptive purposes. The present actual consumption from surface waters is less than 5%. Therefore its contribution as a promoter of economic development remains limited at the moment.

It is estimated that up to 3.7 Million hectares and 30,000 MW of power respectively can be developed using the available potential and clean water supply to all its people. However, only less than 300,000 hectares of the irrigation and 670 MW hydropower potentials respectively have been developed. The clean water supply coverage is only about 34%.

3.2 Hydrology

Temporal Variance of Water Availability

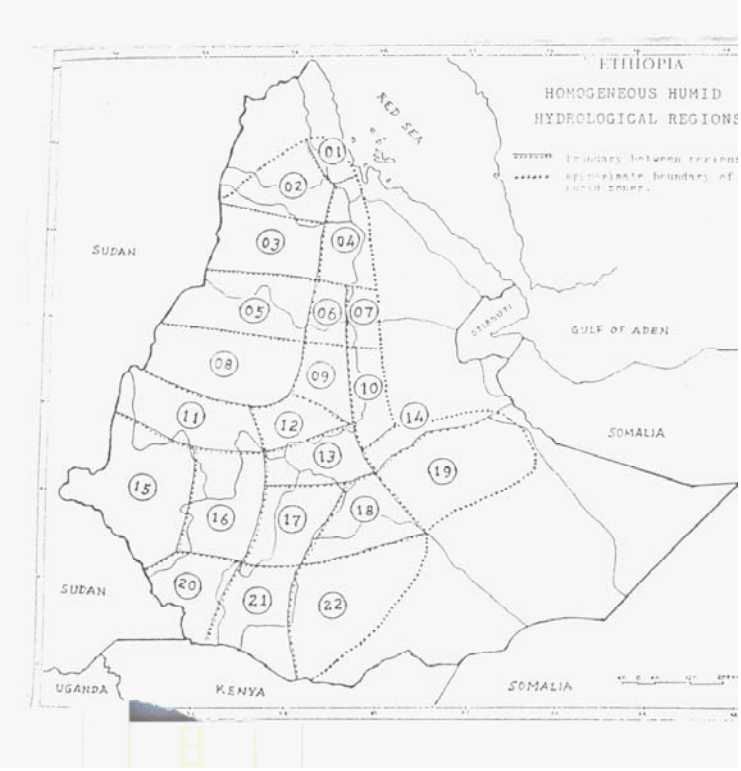
In Ethiopia up to six basically distinct rainfall patterns have been described as follows:

- Bimodal profile with maximum peak from December to February and relative peak in July and August. This pattern is found in the Red Sea Basin.
- Strongly peaked unimodal profile with peak between July to September and dry from October to May. This pattern covers the Mereb-Gash basin, Tekeze-Atbara basin and the northern part of the Abay basin.

- Skewed bimodal profile with absolute peak in August and relative peak in April, and covers the eastern part of the Awash basin.
- Symmetric bimodal profile with peaks in May and August. This covers most of the Wabi Shebele basin
- Skewed bimodal profile with absolute peak in April and relative peak in October, covering the southern part of Rift-Valley and the Genale –Dawa basin
- Strongly flattened unimodal profile with maximum from May to September. This covers mainly the southwestern part of the Abay basin, the Baro-Akobo basin and the western part of the Ghibe-Omo basin.

Although the basic patterns are only six, further subdivision to narrow down the differences in magnitude of monthly profiles revealed 22 homogeneous rainfall regions (Fig 3.1). These basic classifications of regions are supported by similar evaporation and streamflow patterns in order to be recognized as hydrological regions. (Fig 3.2) Shows the pattern for six representative regions as percentages of the annual rainfall.

Figure 3.1: Homogeneous Humid Hydrological Regions



Source: Admasu Gebeyehu, 1996

Figure 3.2: Rainfall Pattern As Percentages of Mean Annual Rainfall for six selected Representative Regions

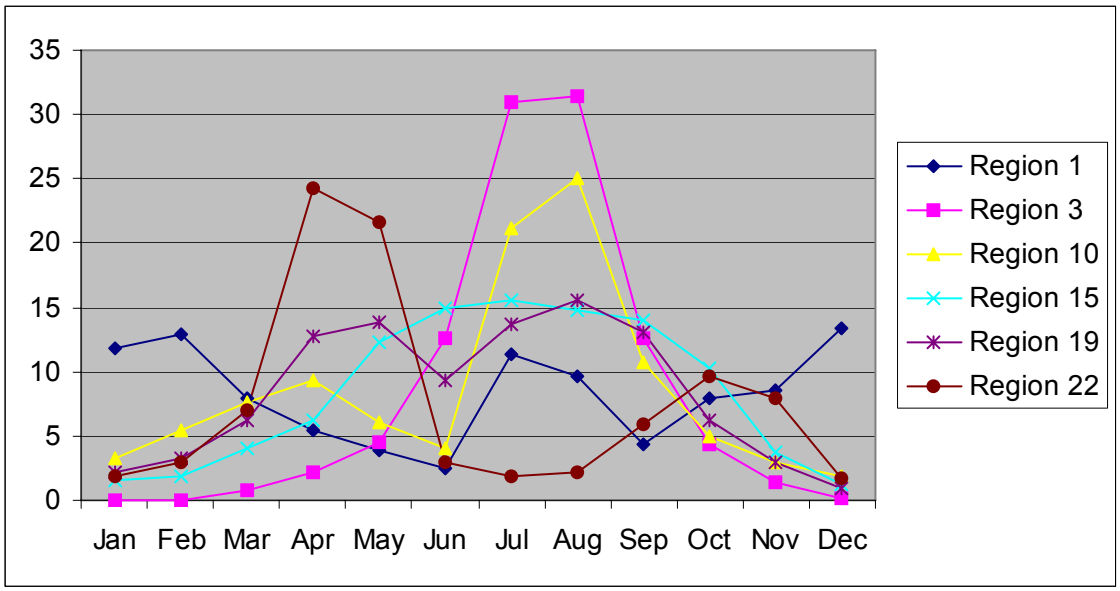
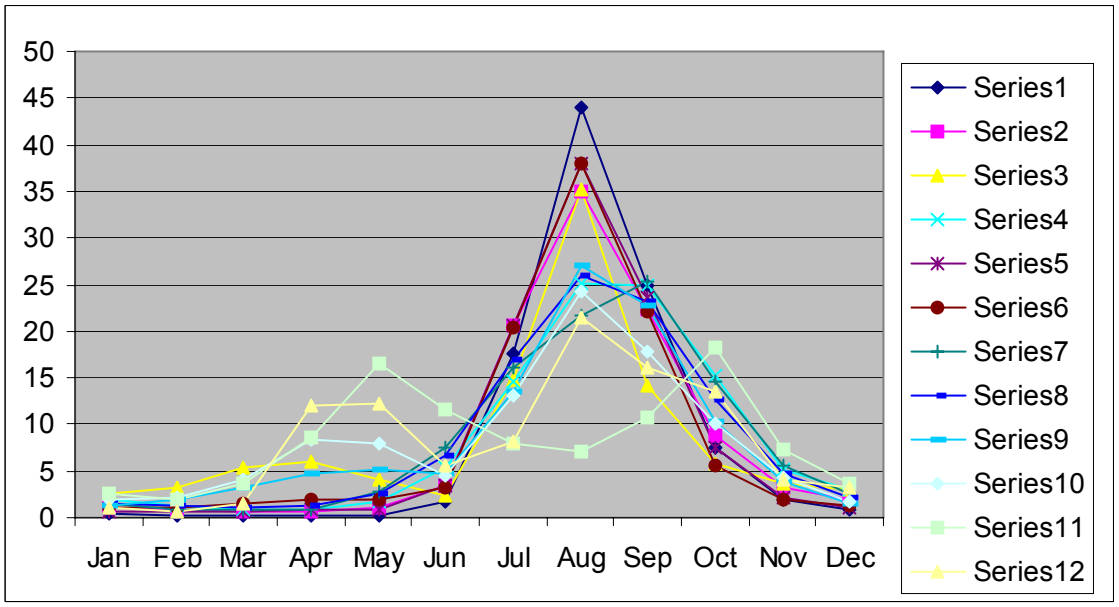


Figure 3.3: The stream flow patterns as percentages of annual for 12 selected regions



3.2.1 Spatial Variance of Water Availability

Climate is the function of the location (latitude), altitude, angle of the sun, distance from oceans or other water bodies, terrain and the like. The different combinations of these factors resulted in the prevalence of diverse climatic conditions in Ethiopia. The major climatic conditions in Ethiopia can be categorized as tropical in the south and south-west , climatic in the highlands and arid and semi-arid in the Northeastern and Southeastern lowlands.

Ethiopia's hydrology is a direct reflection of the climate, the terrain and other physical characteristics. The very high variability exhibited by the climate components of the country

over time and space is the main reason behind the spatial and temporal variability in the availability of water. The following table shows the spatial variation of surface runoff with other climatic variables for the river basins of the country. It can be concluded that the wetter south-west and western part of the country produces most of the runoff, where as the south-east, east, and north comparatively produces very less surface runoff.

To gain an insight into the spatial distribution of the fresh water resources one can note that 83% of the surface water potential is generated in the four basins located on the western portion of the country representing only 40% of the total land area of the country. This clearly demonstrates the uneven spatial distribution of water resources in the country.

3.2.2 Surface Water

Main lakes, Rivers, and Reservoirs

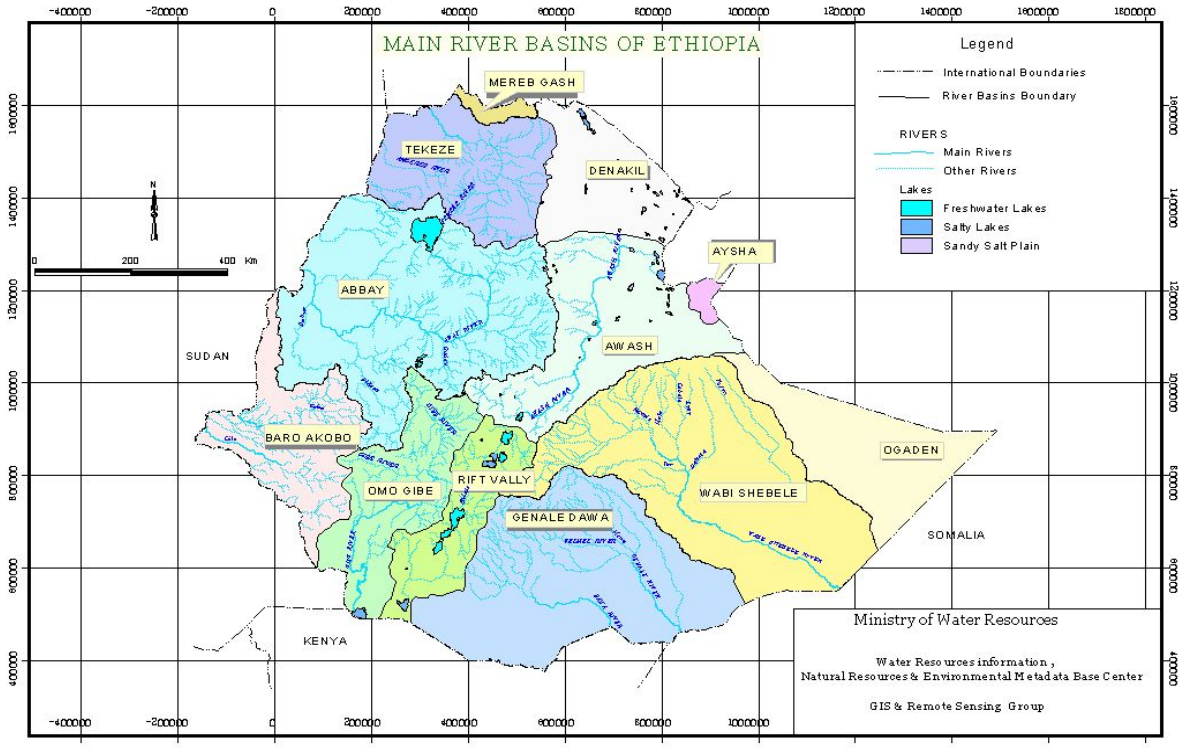
Ethiopia has 9 major rivers (Figure 3.4) and 12 major lakes and 5 Major artificial reservoirs distributed through out the country. All the rivers are international rivers. No perennial flows cross into the Ethiopian river drainage system. Rivers Awash and Omo-Ghibe terminate into the saline lakes of Lake Abe and Lake Rudolf/Turkana which are shared by Ethiopia with Djibouti and Kenya respectively. Both rivers contribute significantly in the water balance and in controlling the levels of the two lakes. The following table summarizes lengths of the major rivers that drain catchments :

Table3.1: Length of Major Rivers

Name of River	Length in KM
Abay	800
Wabi Shebele	1000
Genale	480
Awash	1200
Omo	760
Tekeze	608
Mereb	440
Baro	277
Angereb	220

Source: Stastical abstract 2003-2004

Figure 3.4: River Basins of Ethiopia



In Ethiopia there are only five main dams with significant reservoir storage capacities and they were originally intended for hydropower production. These are Aba Samuel in the vicinity of Addis Ababa on the Akaki River, Koka Dam on the Awash River, Fincha Dam on Fincha River, Melka Wakena on Wabi Shebele River, and Gilgel Ghibe on the Gilgel Ghibe River. There are several other dams in Ethiopia which are small in their capacity to impound water and are category of Micro Dams. The salient features of the five dams is shown the table 3.2 below:

Table3.2: Salient Features of the Major Dams

Name of Dam	Height in m	Original Reservoir Capacity Mm3
Aba Samuel	22	65
Koka	23.8	1860
Fincha	20	940
Melka Wakena	40	765
Gilgel Ghibe	41	839

Most of the Lakes are found in the Rift Valley. The quality of lake waters is poor owing to the presence of extensive saline and alkaline springs in the Rift Valley. Waters of the lakes outside the Rift Valley are fresh. Salient features of the major lakes is shown in the following table:

Table3.3: Major Lakes of Ethiopia

Name of Lake	Area in km2	Depth in M
Abaya	1160	13
Abiyata	205	14
Ashenge	20	25
Awasa	129	10
Bishoftu		85
Chamo	551	10
Hayk	35	23
Koka	250	9
Langano	230	46
Shala	409	250
Tana	3600	9
Ziway	434	4

Source: CSA

3.2.3 Groundwater Resources

The General geology of Ethiopia comprises the following four groups of country rock:

1) Precambrian lower, middle and upper complexes (23%)
2) Upper Palaeozoic and Mesozoic sediments (25%)
3) Cainozoic sedimentary rocks (20%)
4) Cainozoic volcanic rocks (23%)

In the discharge areas where the quaternary cover is lacustrine sediment or where the underlying rock formation is Mesozoic sediment rich in some minerals such as evaporates, gypsum, etc the water from overlying quaternary sediment can be salty either due to upcoming of mineralized water from the underlying stratified rock, due to deep seated structures that circulate high carbon dioxide water, the evaporation effect or or due to the parent material of the reworked sediments (Quaternary deposits)

In the Precambrian rock system limited groundwater resource is available in the weathered and fractured parts in open and usually young structure zones. Otherwise water storage of metamorphic rocks is limited due to sealed nature of old microfractures by late hydrothermal fluid precipitates or alteration minerals related to tectonism and metamorphism, clay end products of most basic metamorphic rocks, which is less permeable, laminated nature o f rocks, due to low precipitation and high evapotranspiration in areas mostly covered by metamorphic rocks and other factors. Fractured/tectonized marble gives high discharges in some areas (over 15 l/sec) sometimes.

The volcanics, especially basalts (usually caniozoic age) extending over large parts of the high lands, can transmit or store water depending on several facrors such as extent of weathering , fracture pattern and suitability of geomorphology and other factors. As rainfall is high in the highland there is an active groundwater regime and the water from the volcanics (basalts) is mostly good quality water. But as there are sequences of volcanic eruptions (stratification or volcanics of different composition and/or paleosoil) the permeability nature of the volcanic aquifer is variable. A lot of springs emerge from the volcanics due to presence of impermeable horizons under permeable layer or due to topographic/structural impact and spring development is a good option in such zones. Even at great depth good quality water can be obtained from basaltic aquifers which show differential weathering and fracturing at each interflow layers. If wells strike underlying Mesozoic sediments rich in shale or evaporite the quality of water can deteriorate or if

interbeding volcaniclastics show compositional complexities water quality may be poor from wells drilled into such horizons.

But in the rift the water from volcanic rocks is poor quality (high fluoride content) due to several factors. The main reasons are the high proportion of acid volcanics which possesses minerals that are sources of fluoride or due high carbon dioxide pressure in the groundwater due to the thermal effects that cause higher dissolution of minerals and cation exchange which in turn increase the fluoride content and other factors that result in fluoride content exceeding 10 mg/l of fluoride in the groundwater.

The remnant Palaeozoic and Mesozoic sediments also form aquifers which supply different amount of water. Mineralogical composition, degree of cementation, fracture and interbedding space, precipitation in the area and geomorphology variations are some of the causes for the variation of yield of water points from these sediments. Generally they form moderate yielding aquifers with good quality water.

The groundwater potential of the country is variable from place to place based on several factors such as variation in geology, nature of structures, recharge condition, nature and duration of precipitation and other factors. Due to economic reasons test wells or sufficient pumping test data is not available that enables to determine hydraulic properties of aquifers, other data such as recharge rate estimation are not sufficient to determine the groundwater potential of the country. However, groundwater is known to be the only or safe water resources to some areas particularly the lowlands adjacent to or far from recharge areas.

For lack of sufficient hydrogeological data, groundwater potential of the country is not known. However, the country wide preliminary water resources master plan study estimates it to be 2.6 billion cubic meters, and to date, only a small fraction of this resource is in use, mainly for local water supply purposes.

3.3 Spatial Variance of Water Quality

All the waters of the rivers with a few exceptions are of good quality with respect to suitability as source of water for drinking and for irrigation with respect to salinity hazard and chemical pollution. However, treatment will be required against biological contamination and turbidity, which is very high in almost all of the river waters. The exceptions to this general rule are the rivers in the Rift Valley Lakes and River Akaki in the vicinity of Addis Ababa. Most of the Lakes in the Rift Valley are of poor quality owing to the presence of extensive saline and Alkaline springs in the Rift Valley. The rivers flowing out to such lakes are also contaminated. In some cases, the saline springs join the rivers directly and affect their quality. Except for two, Zwai and Lake Cheleleka the waters of all other lakes in the Rift Valley are considered unsuitable for drinking and irrigation.

Industrial effluent from big cities such as Addis Ababa can severely deteriorate water quality in a short period of time. Analysis carried out in 1976 at Aba Samuel Reservoir on the Akaki, south of Addis Ababa, was being used as effluent discharge by 26 industries.

As a result the Phosphate and Nitrogen contents being added then to Aba Samuel Reservoir was 175 kg/day. The people and cattle being affected were 20,000 and 10,000 respectively. As no other study was conducted since then it is anticipated that the situation has been aggravated and quality of these areas is expected to worsen.

Mismanagement of irrigation water and the lack of adequate drainage can have a negative impact on the productivity of land. Problem of salinity is evident in some parts of the country. In Amibara Irrigation projec in the Awash Basin, which was brought under full

irrigation in 1983, some part of the irrigated area became barren, covered by thick, white crust salt until a subsurface drainage project was launched in 1990 to remedy the problem on 4000 ha of irrigated land.

3.4 Data and Information on Water Resources

3.4.1 Availability of Hydrological and Meteorological Observation Stations

Rainfall and streamflow measurement in Ethiopia spans the past five decades to the maximum. Most of streamflow and river gauging stations have only been in existence for the last two to three decades. The networks are characterized by uneven and very sparse density in their spatial distribution. Inaccessibility of most of the areas of the country has been the main reason for such unsatisfactory level of distribution of stations. Almost all major towns of the country are located on the highland areas and the road network connecting these towns are aligned along basin divides. Most of the stations have been established on stations that are accessible using these roads. The stations established are on tributaries. There are only very few roads that cross big rivers as such only very few large catchments have been gauged. More than 70% of the rainfall and stream flow gauging stations are located at the head catchments of the river basins.

At the moment there are a total of about 800 weather stations of which about 20% are operated by organizations outside the National Meteorological Services Agency. This is too low considering the 5500 stations required to meet the WMO standard. However, in the short-term plan of the Water Sector Development Plan additional 750 stations will be installed at priority locations that will enable to give early warning on flood occurrence , agro-meteorological information to supply early warning information on effects of climate on crop production to enable timely assessment of the situation of food security in the various parts of the country. Data processing for meteorology is carried out manually except rainfall and temperature data, which are processed by computer.

The national hydrological monitoring network in the country's river basins consists of about 500 gaging stations. To meet WMO standards additional 200 stations will need to be installed. With respect to data analysis, processing and storage, manually processed river stage and discharge data are available in manuscript to the end of 1996 and hydrological year-books up to only 1980 have been prepared. Recently measures have been taken to introduce state-of-the-art technology in the analysis and processing of hydrological data.

A Computer Data Center has now been established and entry of data using 'HYDATA' software has been started. Data entry is now nearly completed. Nevertheless, the system of processing and archiving is not well established as yet. Production of year books may be started in the coming years.

Sediment flow measurement shall be carried out on selected stations relevant to planned dam sites where the problem of soil erosion is very serious, especially on major rivers tributary to the Nile River. In this respect a program of sedimentation monitoring at 16 stations with a support from the European Union has already been initiated and is planned to be expanded to cover more stations on various rivers.

3.4.1.1 Climatic Variability

Rainfall is the most important climatological parameter for crop production and forage in Ethiopia. Rainfall patterns are highly seasonal throughout the country except the South-western region which receives rain for 10 months of the year. The South-eastern part of the

country has typically a bimodal rainfall pattern with a peak in March-May. The rest of the country has a pronounced summer rain which in normal years supports 85% of the total national food production while the remaining portion is produced in the March-May small rainy season. The highlands above the 1500m semi-arid areas primarily support pastoralist.

Other dominant features of rainfall in the country are their variability and quasi-periodicity characterized by anomaly patterns operating on a temporal and spatial scales. According to Workineh (1987), the overall coefficient rainfall variability ranges from 10-50%. The arid and semi-arid regions which constitute 60% of the country's surface area experience a coefficient of variation of 50% whereas the rainfall fluctuation in the South-Western regions is usually less than 20%. Although long-term records are generally lacking, the potential evapotranspiration in the arid and semi-arid areas exceeds precipitation by a factor of more than 4. the high rainfall deviation together with the high evapotranspiration increases the vulnerability of these areas to drought.

Other climatic processes observed in Ethiopia are variations in the onset duration and distributions of rainfalls which have adverse impacts on food production. Frosts which can destroy crops during their growth are also common occurrences in high altitudes.

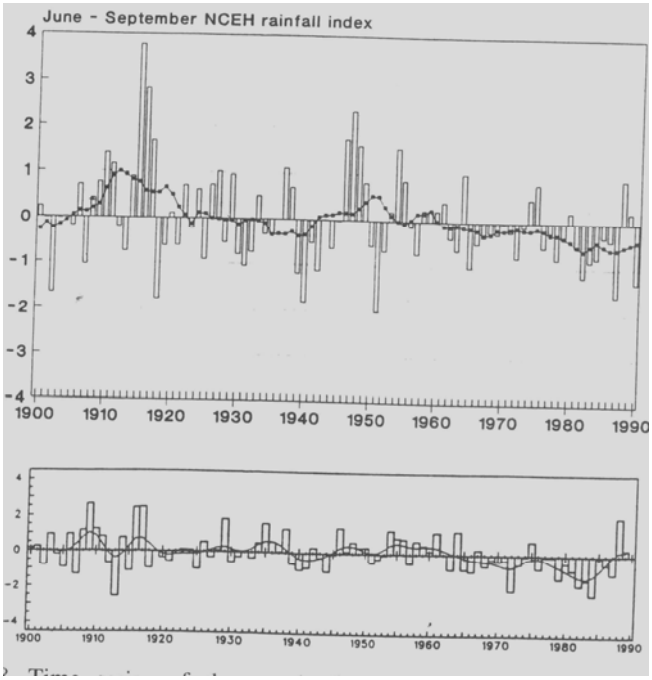
3.4.1.2 Trends of Water Resources through Time

The recurrence of drought is a clear indication of the decreasing trend in the overall moisture availability in terms of rainfall. Areas that used to get enough rain to grow crop in the past have now become arid areas and they have been deserted. They no longer support life in the level they used to do in the long history of the country.

The North Central Ethiopian Highlands are the areas where there is a long tradition of settlement and this area contributes more than 50% of the Blue Nile Catchment in the territory. Study of the long term rainfall and flow data revealed that there is a changing trend in the water resources availability.

The North Central Ethiopian Highlands receive an average annual rainfall of 1184mm and the Abbay (Blue Nile) contributes 43.3% to the main Nile runoff. Assessment of the impact of the decline in rainfall in the North Central Ethiopian Highlands on Blue Nile flow for the period 1965-1984 revealed the anomalies of the June-September (Kremt) rains of the Northern Central Ethiopia highlands revealed corresponding anomalies in the runoff of the Blue Nile during the same period. Past studies estimated changes in annual precipitation and runoff between 1945-64 at 8% and 18% respectively. The decline in rainfall amounts for June-September are estimated to be 14% (Figure 3.5). There is a clear evidence that the rainfall in the North Central Ethiopian Highlands is decreasing from time to time.

Figure 3.5: Rainfall Index



Source: Yilma etal, 1995

A possible driving force for the long-term rainfall deficiency is the Ocean/atmosphere interaction and where, over the same period, a warming of the oceans was observed. This also is true for the Indian ocean, one of the main moisture sources for the Ethiopian rainfall. In particular, it was identified that warm ENSO years were more likely to correspond with below-average main rainy seasons likely to correspond with below-average main rainy seasons in the area.

Linkages of decreasing rainfall with terrestrial ecosystems and/or with land-use/cover changes can be directed in both ways. It was suggested that changes in rainfall pattern may be due to changes in land cover.

3.4.1.3 Data Evaluation

As stated previously the stations both for river gauging and climate were established in those towns that are accessible by road network of the country. Most of the towns are concentrated in the central highlands and the road network in many instances is along catchments divides. The gauging stations are established following these routes and the towns that depend on them fail to be representative of the river basin or catchments in which they are located. Accordingly, the data collected is not fully representative of the climatic situation in the river basin or catchment. The river gauging stations established along these routes represent only a small portion of the catchment or basin and fail to be representative of the whole picture of the catchment.

The length of period of record is another important factor. In some cases there is data going back 45 years. In some stations data is only available for few years. There are many stations where there is huge gap in data collected. Some stations have been abandoned totally.

There are only very few automatic recording stations. In most stations data collection is carried out manually.

There is no frequent updating of rating curves in some streamflow gauging stations. Assessment of many flow gauging stations indicate that the reliability of record is affected by instability of the channel section at the gauging site. The result of such instability can be a change in the shape of the channel form and a change in gauging level of zero flow.

The main reasons for the low quality of data, missing records and inadequate maintenance and management results from lack of resources- equipment, finance, and skilled manpower.

3.4.2 Human Impacts on Water Resources

3.4.2.1 Through Surface Cover

Ethiopia's vegetation cover is declining dramatically with the increasing pressure of land clearance for agriculture, charcoal, and the unsustainable utilization by rapidly expanding human and livestock populations. Natural forest is one important vegetation type upon which attention is focused. It has been estimated in various studies that the area of natural forest has declined from some 30% to less than 4%. Early studies estimated forest clearance are commonly in the range of 100000 to 200000 ha per annum. The impacts of deforestation and vegetation loss and degradation can be classified into ecological/environmental, economic impacts and social impacts. Ecological/Environmental impacts include loss of habitat and genetic diversity (flora and fauna) soil erosion and loss of catchment protection, changes to hydrological regime, deterioration of water quality, and problems of sedimentation.

Deforestation is one main cause of land degradation. The removal of vegetation, whether for cropping, fuel, construction, mining or by grazing, and wind and by changing characteristics of the soil itself, leave the soil more susceptible to erosion.

It is estimated that some 1900 million tons of soil are being eroded annually in the highlands. This is equivalent to an average of 35 tons of every hectare in the highlands. However, most losses are from croplands, totaling an estimated 22% of the land area of the highlands and the remaining 20% is from overgrazed grasslands and littler from waste and other lands. Most of this being deposited as sediment on grass and forest land, but the part that is carried in to rivers is lost carrying away from the highlands some 1900 million tons of soil every year.

Sedimentation of storage reservoirs is a major problem of Dams. All micro-dams and large dams lose important portion of their storage capacities to sedimentation every year. There are even cases where reservoir capacities were filled with sediment within less than five years of operation.

Aggradations of river channels is another problem resulting from sedimentation. For example the stretches of the Awash in the lower valley are a case in example. As a result of aggradations of these stretches the channels have lost their natural capacity to carry floods of even much less than peak flows. Consequently flooding in these areas has now become a yearly phenomena.

There are cases where wetlands have been drained and used for agriculture. Wetlands play significant role in attenuating floods and acting as temporary storages during the wet season. This situation helps in reducing peak flows in the major rivers during the rain season and also contributes to the base flow during the dry season by releasing what is stored during the wet season. This creates a situation where the flow in the wet and dry seasons do not show much variations. Drainage of the wet lands in some areas in the

western part of the country is now affecting the flow regime in the Baro river. The wet season flows are increasing from time to time while the dry weather flow has reduced significantly over the past years.

3.4.2.2 Through Dams and Diversions

Aba Samuel Dam on the Akaki River 30 km south of Addis Ababa, which is the first ever dam to be built in the country, was commissioned in 1939 for hydropower generation. The second in line was the Koka Dam on the Awash River which was commissioned in 1960 for hydropower generation. In the history of development of reservoirs for hydropower generation, water supply, and irrigation that spans barely 60 years, what has been achieved in terms of dam and reservoir is very little. There are only five large dams distributed in three river basins and less than one hundred small dams. There are quite a number of diversion schemes distributed throughout the country. There is no actual inventory of such schemes so far.

All these schemes added together utilize less than 5% of the 122 BM3, which is the current estimate of annual renewable freshwater potential of the country. The large scale reservoirs are all developed for single purpose use of hydroelectric power generation. Some of the schemes viz Awash and Fincha are now feeling the pressure from downstream irrigation developers. The pressure from conflict of interest is very much pronounced in the Awash Basin.

Regulation of Lake Tana by Chara Chara weir and the continuous release of 100m3/sec for power generation is believed to improve the dry season flow of the Blue Nile river flow. In the contrary flood levels of the lake that used to recede early after the rainy season is staying longer than it used to be and as a result many dry season grazing lands remain under water for long. This situation has created expansion of malaria breeding grounds closer to the surrounding communities.

Water harvesting by means of small scale dams and reservoirs for the purpose of drinking water supply and irrigation is practiced in some parts of Ethiopia. The construction of micro-dams for small scale irrigation has intensified considerably since 1995 with most dams being built between 1999-2000 in Tigrai and Amhara Regions respectively. Micro-dams constructed in Ethiopia have water storage reservoirs of 150000m3. In most cases micro dams are not higher than 20-25 meters. Under present conditions out of the 45 dams constructed in Tigrai Region, a regional state in the north of thr country, 35.5% must be considered as failure. The major reasons reported are: orographic effects causing reduced precipitation within the watershed; seepage; and sedimentation. The other main reason for the failure is the rush in implementation without adequate investigation in all aspects.

Traditional river diversion for small-scale and micro-scale irrigation can be found in all regions of Ethiopia. Over the last decade an increase in traditionally irrigated areas has been observed due to the growing pressure to intensify agricultural productions a result of high population growth and shortage of arable land and recurrence of drought. Traditional river diversions are physical structures built with local materials. The diversion structures are normally destroyed by floods during the rainy seasons and have to be built each year. Temporary and seasonal rivers, creaks or galley water is used as long as sufficient water flow can be expected to last at least three months into the dry season. Common risks and problems associated with traditional river diversions is their low durability and the risk associated with their failure.

Modern river diversions are the most common modern irrigation techniques applied in the Southern, Oromia, and Amhara Regions.

Construction of modern river diversion schemes has increased rapidly with the establishment of regional irrigation commissions six years ago. There are socio-economic and administrative issues associated with modern river diversions.

3.5 Water Legislation and Management Issues

The water sector in Ethiopia is undergoing a paradigm shift as a result of Water Resources Management Policy and Proclamation. The proclamation considers that all water resources of the country are the common property of the Ethiopian people and the State (article 5). Although Ethiopian citizens shall have access to sufficient water of acceptable quality to satisfy basic human needs, the management of water resources of Ethiopia shall be in accordance with a permit system (article 6:4). However, domestic use of water shall have priority over all other uses (article 7:1).

The Ministry of Water Resources shall be responsible for the planning, management , utilization and protection of water resources (article 8:1) and it shall determine the allocation and manner of use of water resources among various uses and users(8:1:c).

The right to use water resources for various activities requires permits(article 11:1). Nevertheless, there are water uses for which it is not necessary to obtain licenses (article 12).These are water use from hand-dug wells and use of water for traditional irrigation, artisanal mining , for traditional animal rearing as well as water mills.

Conflict management issues are also dealt by the supervisory body (Ministry of Water Resources). It is mandated to examining and deciding on disputes between permit holders and third party concerning the rights or obligations arising from permits(article 9). In fact, settlement of disputes is usually best managed at a lower level of government structure based on negotiations and local arbitrations.

In addition to the above proclamation, the proclamation for Definition of Powers and Duties of the Executive Organs of the FDRE (Proclamation No. 4/1995) gives the Ministry of Water Resources the power to determine conditions and methods required for the optimum allocation and utilization of water that flows across or lies between more than one Regional Governments among various uses and regions(article 17:1). This implies that Regional States are responsible for managing intra-state waters in their respective jurisdiction.

The paradigm shift in the water sector in Ethiopia has positive developments in formulating policy and legal aspects of water institutions. However, the review of literature and analysis of institutional components in a decentralized environment pose challenges for the water sector in Ethiopia. These challenges are:

3.5.1 Issues of Water Administration

Organizational instability: frequent restructuring and reorganization without studying the existing situations. Moreover, due to the Federal character of the country's political administration, organizational situations differ from region to region

Lack of Coordination and Weak linkages: There are various stakeholders at different echelons of water administration. However, there is no formal linkages and coordination mechanisms between the Federal Ministries and Agencies and even Between the Ministry and Regional Bureaus

Lack of Integrated MIS: Various organizations generate and utilize a wide range of data at all levels. For proper collection, dissemination and accessibility, it lacks integration and coordinated effort, however. Data and information are not transparent and accessible to the stakeholders as required.

Low Community Participation: Although communities play an important role in water resources development and management, due to lack of awareness, community participation continues to be a challenging issue in the sector.

3.6 Main Problems Concerning Water Resources

Institutional and legal issues as problems of water resources have been discussed thoroughly above. Under this the issues of finance in the sector will be covered briefly.

Finance for the sector comes mainly from the national budget as Government contribution and from external source as grant and loan channelled through the Government. The percentage contribution of the Government as budget from the GDP is very small as compared to other priority areas of the Government. The amount approved in the 5-year plan is the ceiling available to be utilized by the sector. But the ceiling level is not rigid it can be shifted depending on circumstances that demand for such shifts.

The picture of financing for the Water Sector as exemplified by the Ministry of Water Resources is summarized below for budget years covering 1995 – 2004:

Table 3.4: Finance for the water sector for 1995-2003 (Birr)

Plan Years	Government Treasury	Foreign Aid	Loan
1995/1996	94,506,900	15,508,200	7,243,000
1996/1997	79,928,200	5,452,800	3,595,600
1997/1998	27,145,500	94,700	44,148,300
1998/1999	11, 093,500	31,926,800	21,276,000
1999/2000	13,041,400	37,227,300	50,418,400
2000/2001	44,928,350	20,818,380	45,161,410
2001/2002	39,187,300	24,757,460	27,692,540
2002/2003	4,900,310	5,697,080	40,207,540
Total	334,731,500	141,482,720	239,742,800

Sources: MoWR

Ethiopia is very much overburdened by long overdue development needs. Today this has been exacerbated by its very low capacity in all aspects. For Ethiopia MDG gives special meaning because with the achievement of the MDG all outstanding developments will be achieved and consequently all social problems which are the fruits of this low level of development will be solved.

Although the objectives and the ultimate goals of MDG are clear in everybody's mind , there are important questions that need to be answered for countries to contemplate its accomplishment: what is the source of the colossus amount of money needed to implement projects? What is the absorption capacity of the recipient countries?

Ethiopia depends largely on external finance for its water resources development. The experience in the past is that it takes many years of negotiation to get even the smallest amount of money.

3.7 Indicators

Indicators for the chapter are summarized in table 3.5 below:

Indicator	2002….2015
1. Annual renewable fresh water 2. Per capita water availability: country wise and basin wise 3. Total non-renewable groundwater resource 4. Temporal and spatial variability of water availability - both surface and groundwater 5. Development potential 6. Annual water use for drinking, industry, agriculture, etc 7. Annual withdrawals as a percent of renewable water resources 8. Annual sediment transport per hectare 9. Annual variability in rainfall 10. Annual variability in runoff 11. Number of MET stations 12. Number of MET stations as percent of WMO standards 13. Number of river gauging stations 14. Number of automatic river gauging stations as percent of total 15. Number gauging stations as percent of WMO standards 16. Groundwater monitoring stations	

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Chapter 4

4. Water for Basic Needs and Health

4.1. Introduction

The Government of Ethiopia has recognized the water sector as one of the strategic sector to get out of poverty.

In 1999 a "Water Resources Management Policy" has been prepared by the Ministry of Water Resources and adopted by the Federal Government as an essential overriding policy document for the development and management of the nation's water resources.

Subsequently the Water resource management proclamation has been ratified by the parliament, the sector strategy and development programs were completed by mid 2002.The Water Sector Development Program (WSDP) has a planning time horizon of Fifteen years (2002-2016). Earlier, the MoWR has undertaken the preparation of river basin master plans for most of the nation's major river basins. The WSDP has identified priority projects and worked out a detailed implementation plan using the basin master plan studies, among others.

According to the 1994 census, Ethiopia had in 1994 a population of 53.5 million, equally divided between male and female. The 1999 Statistical Abstract of the CSA estimates the population of Ethiopia to be 63.5 million on July 1, 2000, 83.5million by 2010 and 106 million by 2020. These projections imply annual average population growth rates of 2.90%, 2.77%, and 2.42%, respectively between two successive years of projection, starting from the actual census year (1994).

Ethiopia's population is 85% rural and 15% urban. The population group, which is active, comprises 49.6 percent of the total population.

Two types of major migration patterns have been established by the 1994 census. These include rural-urban and inter-urban. By far, the former is the most dominant migration pattern. In 1994, the estimated number of migrants in the country was 6.9 million.

4.2 Objectives

Millennium Development Goals are a result of several consultations that have been made since the mid 1990s on several international forums regarding global poverty and human deprivation. At the occasion of the Millennium Summit, in September 2000, 147 heads of state and Governments and 191 nations adopted the Millennium declaration. The Declaration has mainstreamed a set of inter-connected and mutually reinforcing development goals and targets into a global agenda.

Millennium Declaration centres on democracy, peace, human rights and poverty , education, among other primary development challenges and eight major goals referred to as MDGs'. There are 18 specific targets set across the eight goals and more than 4 indicators to monitor these targets.

In the millennium declaration adopted by the General Assembly in 2000, World leaders resolved to have by the year 2015, the proportion of the world's people who are unable to reach or to afford, safe drinking water and stop the unsustainable exploitation of water resources.

Water Resources also figured prominently at the world summit on sustainable development in Johannesburg in 2002. The plan of implementation adopted there reiterated the Millennium Development goal on water, set a new target of halving the proportion of people who do not have access to basic sanitation by 2015, and recognized the key role of water in combating poverty and in the realms of agriculture, energy, health, biodiversity and ecosystems.

The objectives of this report is therefore two folds, that is

- Preparation of a National Monitoring, Evaluation and Reporting system framework for the water Sector in Ethiopia through
- Production of the first National Water Development Report that is the preparation of the water supply and sanitation water and Health and water and Industry chapter of the National Development report.

4.3 Existing Situation Analysis

4.3.1 Water Supply and Sewerage

Water is a basic need in sustaining life; only a minority of Ethiopians has an access to potable water. Urban areas receive better service than rural. About 65 percent of urban areas (excluding Addis Ababa) are covered, while only 15 percent of rural areas receive water supplies. Sewerage is provided to a very limited extent.

4.3.2 Water Supply Service Coverage

According to the 1994 second National CSA survey, only 24% of the housing units in the country used a safe source of water, 14% through piped (tap) water, 10% from protected springs. The rest, 76% of the country's population used "unsafe" water, such as from unprotected springs and wells or directly from rivers. In 1994 this concerned over 40 million people. In 1998 the situation had not improved; still 77% of the population using unsafe water. It then concerned 46 million people. See table 4.9 below.

Table 4.9: Use of safe and unsafe water sources, country-wide, 1998

Type of population	Number of people (year 2000)	Using safe source		Using unsafe source	
		Piped water	Protected Spring	Unprotected Spring or well	River or pond water
Urban	9.5 million	84%	8%	4%	5%
Rural	54 million	5%	12%	44%	39%
Total	63.5 million	17%	11%	38%	34%

Source: CSA1998

There were some variations in service coverage among the various regions. Table 4.10 gives a summary, stating the percentage of housing units having access to safe water.

Table 4.10: Access to safe water, by region (2001)

Regional State	Overall	Rural areas	Urban areas
Addis Ababa	70%	0%	70%
Dire Dawa	59.5%	37%	68%
Harari	22.7%	19%	25%
Gambela	17.6%	14%	35%
Oromiya	31.2%	25%	76%
Amhara	30.7%	23%	96%
Tigray	34.1%	29%	59%
SNNPR	28.6%	24%	83%
Benishangul-Gumuz	20.3%	18%	43%
Somali	13%	7%	46%
Affar	16.5%	14%	44%
Total country	30.9%	23.1%	74.4%

Source: MOWR

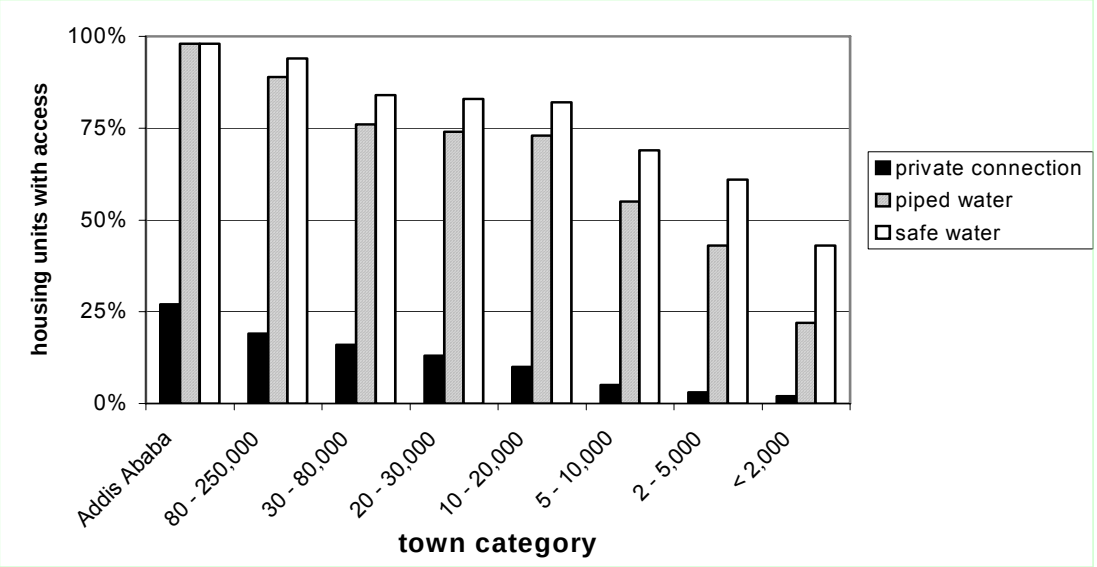
The city-states of Addis Ababa, Dire Dawa and Harar score highest because of the large urban proportion of the population. The survey even claims a near-full coverage in the towns.

The four largest regions score close to the national average. The smaller regional states, especially Affar and Somali, score low.

4.3.3 Urban Water Supply Coverage

The CSA 1994 census is the most extensive database on service coverage, because it provides information for almost all towns and woredas.

Figure 4.2: Access to Water, Urban Population (CSA 1994)



4.3.4 Rural Water Supply Coverage

Table 4.11 provides CSA statistics on rural water supply coverage (regional summaries) for two years: 1994 and 1998.

According to CSA, the "city states" Dire Dawa, Addis Ababa and Harar have made good progress in the expansion of water services in their (small) rural areas. Credit apparently also goes to Somali, Tigray, Affar and Gambela where the rural coverage has increased. However, as an average in the country the coverage has not increased, due to the drop in the largest states of Oromiya, Amhara and SNNPR.

Table4.11: Rural areas, access to safe water, by region 1994 and 1998

Regional State	Rural areas, 1994	Rural areas, 1998	Rural areas, 2000
Dire Dawa	23.6%	64.7%	57.2%
Gambela	21.3%	21.3%	24.6%
SNNPR	15.5%	14.6%	20.4%
Oromiya	15.8%	14.2%	17.4%
Amhara	15.2%	11.2%	11.3%
Benishangul-Gumuz	14.8%	13.3%	22.1%
Harari	11.2%	34.5%	47.7%
Tigray	10.6%	17.5%	25.6%
Somali	9%	14.3%	22.5%
Affar	5.2%	8.7%	7.7%
Total country	14.7%	13.7%	17.1%

Source: CSA 1994 and 1998

The Sector Review Report prepared for the Water Sector Development Programme provides more recent – region specific - information about rural water supply coverage. Table4.12 gives an abstract. The information was provided by the regional water bureaux (RWB).

Table 4.12: Rural areas, access to safe water, by region 1995 and 2000 Information from Regional water bureaus

Regional State	1995		2000	
	Rural	Total	Rural	Total
Addis Ababa		78%		69%
Dire Dawa			37%	59%
Gambela			22%	28%
SNNPR		20%		28%
Oromiya	18%	23%	23%	30%
Amhara	5%		23%	31%
Benishangul-Gumuz	12%		27%	25%
Harari				
Tigray		10%		34%
Somali				19%
Affar			14%	16%
Total country				31%

Source: MoWR, WWDSE 2001

Blanks mean: no information available

Several sources suggest that a large percentage of rural schemes are not functional at any given time. Table 4.13 show data based on an extensive 1996 MoWR survey..

Table 4.13: Non-functionality of rural water supply schemes

Regions	All surveyed		Springs		Hand pumps		Boreholes	
	Total	Non-func.	Total	Non-func.	Total	Non-func.	Total	Non-func.
Benishangul	125	67%	9	0%	116	72%	0	
Gambela	102	48%	10	0%	14	0%	78	63%
Somali	56	34%	0		0		56	34%
SNNPRS	830	32%	155	10%	208	37%	467	38%
Oromiya	2571	24%	1305	16%	856	27%	410	42%
Amhara	634	22%	359	27%	248	17%	27	0%
Tigray	686	18%	45	27%	208	24%	433	14%
Totals	5004	26%	1883	18%	1650	29%	1471	33%

Source: Ernst & Young 1997

Traditional sources may often provide inconvenient source of water. Often they are situated at large distances from residents, necessitating women to walk for several hours with heavy loads of water. Yields may reduce significantly during longer dry periods, forcing the water carriers to use lower quality water at even larger distances from their homes. Table 4.14 illustrates the distances people in rural areas have to walk to fetch water

Table 4.14: Distances to Nearest Water Source

Distance(Km.)	Percentage of Rural Population
Less than 1	63.8%
1 – 4	30.4%
5 – 9	4.0%
10 – 14	0.8%
More than 15	0.7%

Source: CSA 1998

4.3.5 Sanitation

The sanitation situation in Ethiopia is very inopportune; the development is very limited and has not been a main concern. Most of the population in rural and urban areas do not have access to safe and reliable sanitation facilities. Majority of households do not have sufficient understanding of hygienic practices regarding food, water and personal hygiene. As a result above 75 % of the health problems in Ethiopia are due to communicable diseases attributed to unsafe and inadequate water supply, and unhygienic waste management, particularly human excreta.

The sanitation situation in the country has not been a priority in the past and the development is very low and in-need of efforts and attention.

The major health problems of Ethipoia, like that of any developing nation are communicable diseases related to water and sanitation. The status of water and sanitation services in the country is very poor and majority of the population do not have access to potable water supplies and sanitation facilities.

Many infectious diseases are associated with human excreta; the most common association is that the disease causing organisms leave an infected person by way of the feces and urine.

Human excreta is therefore associated with a large number of diseases. With proper disposal of human excreta by inexpensive methods, these diseases can be brought under control and the entire sanitation situation of the country can be improved.

Human excreta are thus, the principal source for the transmission and spread of a wide range of diseases that are the chief causes of sickness and death in society.

The hygienic management and disposal of human excreta are thus of central importance in the control of excreta related diseases. It is estimated that less than 10% of the population in the country has access to excreta disposal facilities of any kind.

As a consequence of this, diseases that are directly or indirectly related to poor sanitary condition are prevalent in most parts of the country. This is especially true in urban areas where overcrowding is very high. These all shows that the sanitation status in Ethiopia is very poor and the deficit of latrines and other various sanitation facilities are enormous and call for the attention of the government.

In Ethiopia, the use of sanitary latrines is very limited. There are only few data available showing the severe condition of the country.

In the country conventional sewerage system is almost not known, even in the capital Addis Ababa, comprising the population of around 2.85 million, only 2 % of the inhabitants with a limited system.

However from the results of various reports and sample surveys made by governmental and non-governmental organizations at different periods that the sanitation status of the country is without doubt at the lowest level. The situation is most serious and major plans are required if any considerable impact is to be made on the problem in the next few decades.

Health and Health related indicators of the federal democratic republic of Ethiopia, Ministry of health four series of brochures demonstrated the sanitation situation of the country as indicated in the table 4.15

Accurate and recent countrywide data on sanitation coverage is not available in the country and one of the shortcomings of sanitation sub sector in the country is the non-availability of recent countywide complete sanitation data, on the other hand the first and the second national population and housing census of Ethiopia, conducted in the years 1984 and 1994,incorporated different set of parameters on housing characteristics and conditions and were collected information on housing facilities and amenities, such as toilet types, bathing. Specially in the second national census the availability of sanitary conditions was considered to be the most precious indicator and was associated with the quality of the housing unit, besides this the availability of the safe and efficient disposal of human waste was considered among the first basic steps, which should be taken towards assuring a suitable environment for the well- being of the population.

Among with the provision of water supplies, the safe and efficient disposal of human waste is one of the measurements of environmental sanitation. From the census, thus data were obtained on whether the housing units have toilet (an installation for the disposal of human excreta) facilities. Hence the CSA data on toilet and bathing facilities are presented in tables 3.8 and 3.11.

In the first population and housing census of Ethiopia in 1984,12% of households have pour flush toilets, 57% of households have pit latrines and 31% have no sanitation facilities at all in the capital Addis Ababa.

In the 1984 population and housing census of Ethiopia in the other urban towns 3% have flush toilets 49% have pit latrines and 48% have no sanitation facilities. Of the households having pit latrines in urban towns, 37% have shared facilities used by a number of families. Those with no facilities defecate indiscriminately in open areas and fields.

In the second population and housing census of Ethiopia in 1994, 11.99% of households have pour flush toilets, 63.14% of households have pit latrine, 23.89% have no sanitation facilities at all and 0.98% not stated in the capital Addis Ababa.

In the 1994 population and housing census of Ethiopia, in other urban towns 3.29% have flush toilets 46.97% have pit latrines and 48.57% have no sanitation facilities. Of the households having pit latrines in urban towns, 20.71% have shared facilities used by a number of families. Those with no facilities defecate indiscriminately in open areas and fields.

In the 1998 welfare monitoring survey statistical bulletin No.224 indicated at the country level 83.3% of households have no toilet facilities and use open defecation, 14.6 % household use pit latrine facilities, while 1.4 % household use flush toilets.

In the 1998 welfare monitoring survey (CSA) pointed out, 11% of the households have flush toilet, 73.3% of the households have pit latrine, 3.1 % of the households use household containers.10.5% of households use open defecation (field and forest) and 2.2% of the households use other means in the capital Addis Ababa

The sanitation situation in Ethiopia is on a very low scale: the poorest compared to other East African countries. According to the World Development Report of 1996 only 10% of the Ethiopian population had access to proper sanitation, compared to 30%, 60% and 77% in Kenya, Uganda and Tanzania respectively.

The Ministry of Health (MoH) regularly publishes brochures reporting on the country's health and health related indicators. Table 4.15 gives an indication of the Ethiopia's progress in sanitation development: it claims a steady progress. But this is not fully competitive with that of other sources.

Table 4.15: Sanitation: use of latrine in Ethiopia

Residence	1994	1995	1997	1998
Rural	1%	1%	5.7%	7%
Urban	60%	60%	55%	71%
National	8%	10%*	12.5%	26%

Source: MOH & World Development Report, 1997

The Sanitation Sector Strategy Paper of 1987 (WSSA) estimated the overall access to sanitary latrines at 7% of the population. In towns the coverage was 54%, in rural areas only 4%. These figures are similar to those mentioned in table 4.15 above, but especially the rural coverage is considerably higher. One reason for the difference may be variations in definitions.

The 1994 CSA survey conducted provided nation wide data, specified per woreda and town, and is therewith the most comprehensive data set. Table 4.16 gives an abstract, which shows that in 1994, 87% of the country's population, or over 46 million people did not use a sanitary toilet.

The CSA Welfare Monitoring Survey of 1998 provides data on access to sanitary latrines by zone and for a selected number of towns. Percentage-wise there were less people without access (83%), but in absolute numbers the situation did not improve, with nearly 50 million people not using latrines. The improvements over the 4-year period took place in Oromiya, Benishangul and SNNPR. Amhara, Tigray and Affar and Somali showed a decline.

Table 4.16: Access to sanitary facilities, by region (1994)

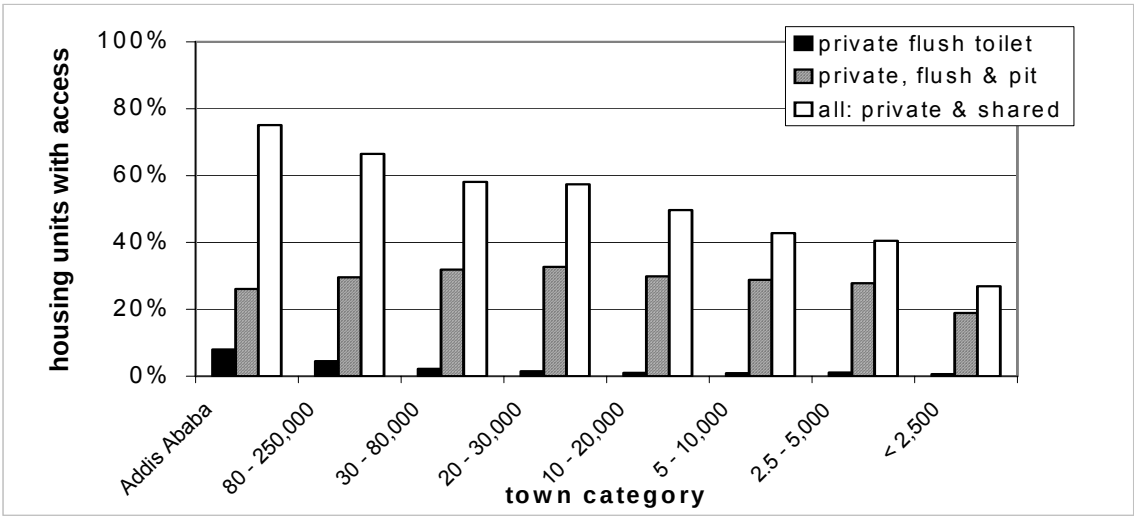
Regional State	Overall	Rural areas	Urban areas
Addis Ababa	74%	5%	75%
Dire Dawa	55%	3%	75%
Harari	42%	1%	69%
Benishangul-Gumuz	19%	15%	63%
Gambela	15%	11%	31%
SNNPR	13%	9%	63%
Oromiya	13%	7%	59%
Somali	11%	4%	48%
Affar	8%	4%	37%
Tigray	7%	3%	29%
Amhara	6%	3%	37%
Total country	13%	6%	57%

Source: CSA 1994

The city-states of Addis Ababa, Dire Dawa and Harar score relatively high again, with 2/3 to ¾ of the town populations using a sanitary toilet. Review of more detailed data reveals that the use of flush toilets was only reserved to 12%, 7% and 8% of the dwellers of the three respective towns. In Addis Ababa this meant 45,000 households only, of which 1/3 use them as a shared facility.

The coverage is considerably better in towns than in rural areas. Figure 4.3 illustrates access to various types of facilities by town-size. The general picture is that people living in larger towns are better off.

Figure 4.3: Access to Sanitation, Urban Population (CSA 1994)



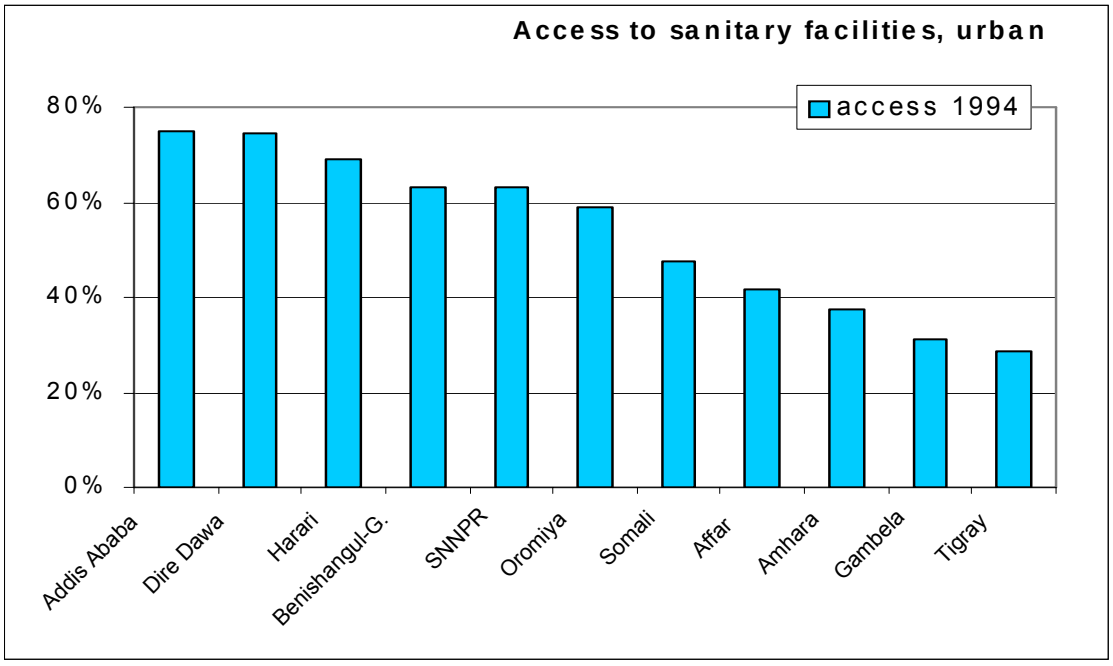
The quality of latrines is generally poor., as per the National Water Supply and Sanitation Master plan frame work Report, over 50% are structurally unsafe and 50% hygienically inappropriate. It seems that households require assistance in these areas.

Public sanitation services such as public toilet facilities, sludge (septage) collection and related environmental health services, they are generally inadequate and do not meet demands. Addis Ababa is the only town with a small sewerage system with only 15,000 people, or 0.6% of the population connected.

4.3.5.1 Urban Sanitation Coverage

Figure 4.3 shows the access to sanitary facilities in towns by region. It shows a relative low coverage in Tigray, Gambela and Amhara.

Figure 4.4: Accesses to Sanitary Facilities, Urban, by Region



source: CSA 1994

The use of flush toilets in other towns than Addis Ababa was very low: 3% only. In fact, in 1994 half of the country's flush toilets were in Addis.

Table 4.17 shows the availability of toilet facilities in Addis Ababa over a 14-year period and indicates that there has been an improvement: the percentage of households using pit latrines has increased, and that of households without facilities decreased. However, in absolute figures the number of people without latrines didn't change much over the years. In 1984 there were about 440,000 of them, in 1998 still around 350,000, not such a drastic decrease as the halving of the percentage-figure from 31 to 15% would suggest.

Table 4.17: Addis Ababa, coverage with sanitation facilities

Types of facilities*)	Year 1984	Year 1994	Year 1998
Pour-flush	12%	12%	11%
Pit latrine	57%	63%	73%
No facility	31%	24%	15%

Sources: all CSA

Of the 11% of the population using pour-flush latrines (i.e. 260,000 people), only 13,600 have a connection to the small sewer system. The others (probably) use septic tanks.

Table 4.18: Other urban areas, coverage with sanitation facilities

Types of facilities	Year 1984	Year 1994	Year 1998
Pour-flush	3%	3%	5%
Pit latrine, private	12%	26%	37%
Pit latrine, shared	37%	21%	
No facility	48%	49%	58%

Sources: all CSA

Table 4.18 shows similar information, but for the other towns in Ethiopia outside Addis Ababa. The situation between 1984 and 1994 stayed the same, except for the shift from shared to private pit latrines. However, the 1998 survey showed deterioration.

The 1994 census has information for each town. Figure 4.4 illustrates the access households have to sanitation facilities as a function of the town size. The general picture is that people living in larger towns are better off.

While more than 60% of the households in the largest towns have access to any type of latrine (either privately owned or shared), in the smaller towns this is 40% and less. The use of private latrines (either a pit latrine or a flush-type) is similar in all towns: around 30%. It is remarkable that in the largest towns this is less than in the medium-sized towns. The cause may be the larger low-cost residential areas in the first group, where sharing of toilet facilities may be more common due to lack of space.

The possession of private flush latrines in more common in the largest towns: from 8% in Addis Ababa and 4.5% in towns larger than 80,000 inhabitants, to 2% and less in the smaller towns.

The CSA census also provides information on the use of bathing facilities. A summary per town category is given in table 4.19. It shows that less than 7% of the urban residents use a bath or shower. The variation over town-sizes is not very large, with Addis Ababa and the largest towns scoring somewhat better. Showers are more common than baths, while sharing of a facility is less common than for toilets (see figure above).

Table 4.19: Urban Access to Bathing Facilities

Size Group	None	Bath		Shower		Other
		Private	Shared	Private	Shared	
Addis Ababa	90.4%	3.9%	0.3%	3.9%	0.7%	0.7%
80 - 250,000	91.4%	1.1%	0.3%	3.7%	1.5%	1.4%
30 - 80,000	96.8%	0.5%	0.2%	1.0%	0.3%	0.8%
20 - 30,000	95.2%	0.1%	0.2%	1.4%	1.5%	0.9%
10 - 20,000	95.6%	0.3%	0.1%	0.8%	0.6%	1.8%
5 - 10,000	97.8%	0.9%	0.0%	0.2%	0.1%	0.5%
2.5 - 5,000	92.7%	0.5%	0.0%	1.5%	3.6%	1.3%
1.0 - 2,500	98.6%	0.2%	0.0%	0.3%	0.4%	0.1%
< 1,000	94.2%	0.0%	0.3%	0.3%	0.3%	3.2%
Average	93.6%	1.5%	0.2%	2.2%	0.8%	1.3%

Source: CSA 1994

As for water supply, the 1994 CSA survey provides the most comprehensive information. And as for water supply.

4.3.5.2 Rural Sanitation Coverage

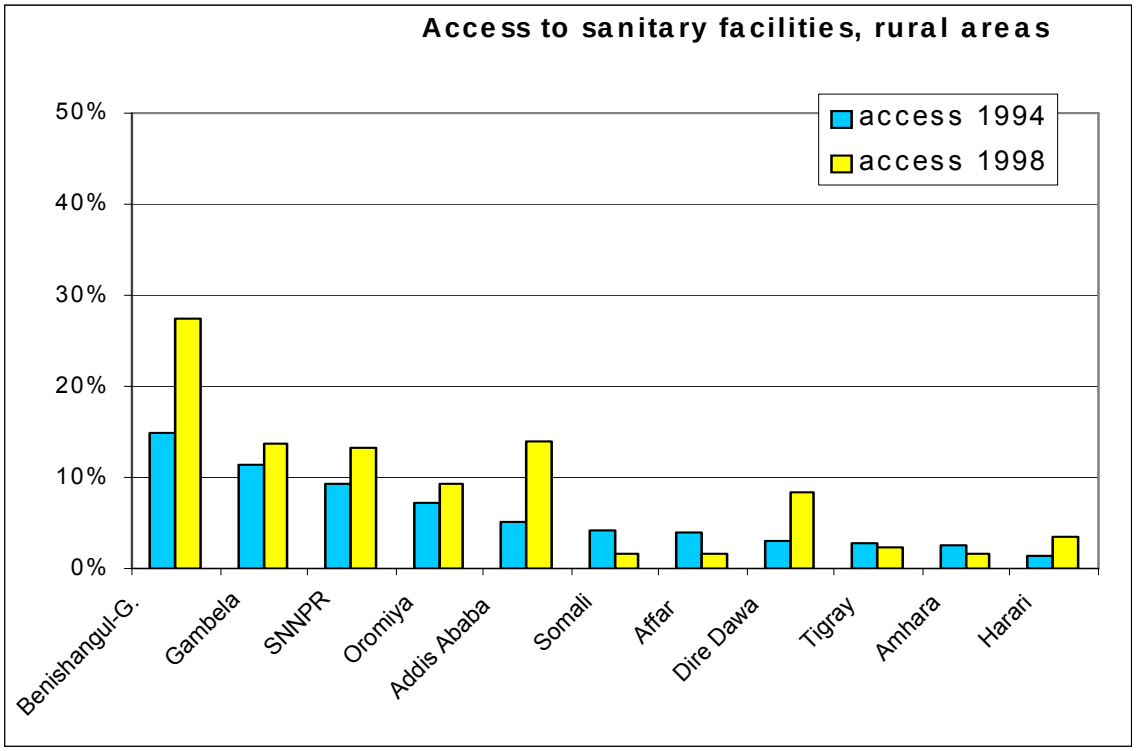
In 1998 CSA carried out a Welfare Monitoring Survey, giving information on sanitation facilities per zone and for a small selection of towns. In table 4.20 and figure 4.4 we have compared the 1998 sample data with those of 1994, for rural areas only. The picture shows a small improvement, mainly caused by the claimed improvements in Oromiya and SNNPR.

Table 4.20: Comparing 1994 census and 1998 sample data, Percentage of population without latrine, rural areas

Regional State	Rural areas	
	1994	1998
Addis Ababa	95%	85%
Dire Dawa	97%	91%
Harari	99%	97%
Benishangul-Gumuz	85%	77%
Gambela	89%	86%
SNNPR	91%	86%
Oromiya	93%	90%
Somali	96%	98%
Affar	96%	98%
Tigray	97%	98%
Amhara	97%	97%
Total country	94%	92%

Source: CSA 1994 and 1998

Figure 4.5: Access to Sanitary Facilities, Rural, by Region



It is remarkable that the regions with the lowest coverage also show a stand-still: Tigray, Affar, Somali and Amhara.

4.3.6 Water Supply and Sanitation/Sewerage Goal

The goal of water supply and sanitation as stipulated in the Ethiopian water resources Management policy is to enhance the well-being and productivity of the Ethiopian people through provision of adequate, reliable and clean water supply and sanitation services and to foster its tangible contribution to the economy by providing water supply services that meet the livestock, industry and other water users' demands.

Specific objectives in achieving the Water Supply and Sanitation policy goal are to:-

- Provide as much as conditions permit, sustainable and sufficient water supply service to all the peoples of Ethiopia.
- Satisfying water supply requirements for livestock, industries and other users as much s conditions permit.
- Carry out operation and maintenance of all water supply and sanitation services in a sustainable and efficient manner.
- Ensure protection and conservation of resources and control pollution and wastage as part of management policy
- Ensure sustainable resources development through development of human resources at all levels, legislation and the regulatory framework, and other appropriate means of capacity building.
- Enhancing the well being and productivity of the people by creating conducive environment for the promotion of appropriate sanitation services.

4.3.6.1 Target for Water Supply and Sanitation/Sewerage Sector

As to the water sector Development programme published on June 20002 by MOWR the water supply and sewerage targets were set by Regions them selves, taking into account regional population projections for urban and rural areas by the central Statistical Authority (CSA). Water supply and sewerage Development targets were set for the three sub-periods of water sector development programme horizon, starting point being the existing coverage levels in each region. Region wise targets for the program period are presented in the tables 4.21., 4.22, 4.23 below.

Table 4.21: National Water Supply Targets and Population to be served in the Planning Period

		Existing Situation 2001			End of 2006			End of 2011			End of 2016		
No.	**Region**	**Total Population ('000)**	**Cover-age %**	**Pop. To be Served ('000)**	**Total Population ('000)**	**Cover-age %**	**Pop. to be Served ('000)**	**Total Population ('000)**	**Cover-age %**	**Pop. to be Served ('000)**	**Total Population ('000)**	**Cover-age %**	**Pop. to be Served ('000)**
	Addis Ababa	2,570	70	1,799	2,973	95	2,824	3,418	100	3,418	3,883	100	3,883
	Afar	1,243	16.5	205	1,389	32.6	453	1,540	48.8	752	1,695	65.1	1,103
	Amhara	16,748	30.7	5,136	19,120	43.2	8,266	27,175	55.5	12,045	24,484	67.3	16,476
	Benishangul Gumuz	551	20.3	112	625	40.5	253	706	52.5	371	791	64.5	510
	Dire Dawa	330	59.5	196	398	70.6	281	474	92.0	436	555	97.8	543
	Gambella	216	17.6	38	247	28.0	69	279	44.2	123	311	53.0	165
	Harari	166	22.7	38	196	29.5	58	228	78.7	179	265	90.6	240
	Oromiya	23,023	31.2	7,175	26,553	47.6	12,632	30,410	65.8	20,019	34,476	83.2	28,685
	Somali	3,797	13.0	464	4,329	23.6	1,023	4,919	40.8	2,006	5,537	56.9	3,151
	South (SNNPR)	12,903	28.6	3,691	14,902	38.3	5,709	17,035	50.2	8,548	19,247	71.3	13,725
	Tigray	3,797	34.1	1,296	4,335	52.9	2,293	4,923	72.2	3,557	5,551	92.3	5,122
	National	65,344	30.9	20,180	75,067	45.1	33,862	85,647	60.1	51,453	96,795	76.0	73,604

Table 4.22: Urban Water Supply Targets and Population to be served in the Planning Period

		Existing Situation 2001			End of 2006			End of 2011			End of 2016		
No.	Region	Tot. Urban Population ('000)	Urban Cover-age %	Urban Pop. to be Served ('000)	Tot. Urban Population ('000)	Urban Cover-age %	Urban Pop. to be Served ('000)	Tot. Urban Population ('000)	Urban Cover-age %	Urban Pop. to be Served ('000)	Tot. Urban Population ('000)	Urban Cover-age %	Urban Pop. to be Served ('000)
1	Addis Ababa	2,570	70	1,799	2,973	95	2,824	3,418	100	3,418	3,883	100	3,883
2	Afar	103	44	45	126	59	74	154	74	114	186	90	167
3	Amhara	1,759	96	1,689	2,195	99	2,173	2,754	100	2,754	3,411	100	3,411
4	Benishangul Gumuz	50	43	22	62	63	39	77	73	56	94	83	78
5	Dire Dawa	239	68	163	296	78	231	362	100	362	435	100	435
6	Gambella	37	35	13	47	45	21	59	60	35	71	80	57
7	Harari	101	25	25	122	25	31	146	92	134	173	100	173
8	Oromiya	2,782	76	2,114	3,523	84	2,959	4,432	100	4,432	5,520	100	5,520
9	Somali	586	46	270	735	56	412	917	66	605	1133	76	861
10	South (SNNPR)	1,008	83	837	1,277	95	1,213	1,604	100	1,604	1,991	100	1,991
11	Tigray	651	59	384	816	87	710	1,019	100	1,019	1,262	100	1,262
12	Urban National	9,886	74.4	7,360	12,172	87.8	10,687	14,942	97.3	14,534	18,159	98.2	17,838

Table 4.23: Rural Water Supply Targets and Population to be served in the Planning Period

		Existing Situation 2001			End of 2006			End of 2011			End of 2016		
No.	**Region**	**Total Rural Population (/000)**	**Rural Cover-age %**	**Rural Pop. to be Served ('000)**	**Total Rural Population (/000)**	**Rural Cover-age %**	**Rural Pop. to be Served ('000)**	**Total Rural Population (/000)**	**Rural Cover-age %**	**Rural Pop. to be Served ('000)**	**Total Rural Population (/000)**	**Rural Cover-age %**	**Rural Pop. to be Served ('000)**
	Addis Ababa												
	Afar	1,140	14	160	1,263	30	379	1,386	46	638	1,509	62	936
	Amhara	14,989	23	3447	16,925	36	6,093	18,961	49	9,291	21,073	62	13,065
	Benishangul Gumuz	501	18	90	563	38	214	629	50	315	697	62	432
	Dire Dawa	91	37	34	102	49	50	112	66	74	120	90	108
	Gambella	179	14	25	200	24	48	220	40	88	240	45	108
	Harari	65	19	12	74	37	27	82	55	45	92	73	67
	Oromiya	20,241	25	5,060	23,030	42	9,673	25,978	60	15,587	28,956	80	23,165
	Somali	3,211	7	225	3,594	17	611	4,002	35	1,401	4,404	52	2,290
	South (SNNPR)	11,895	24	2,855	13,625	33	4,496	15,431	45	6944	17,256	68	11,734
	Tigray	3,146	29	912	3,519	45	1,584	3,904	65	2,538	4,289	90	3,860
	National Rural	55,458	23.1	12,820	62,895	36.8	23,175	70,705	52.2	36,919	78,636	70.9	55,765

4.3.8 Water and Health

Ethiopia has one of the worst health status in the world as could be attested by conventionally accepted selected heath indicators shown below in the table. At the centre of the problem is the backward socio-economic development resulting in one of the lowest standard of living, poor environmental conditions and low level of social services. This prevailing situation has been aggravated, in recent years, by the high population growth, the two decades of strife and civil war, the repeated natural disasters, the degradation of environment and the associated low productivity of land.

Infant Mortality Rate (IMR)	110/1000 LB
Child Mortality Rate(CMR)	99/1000c
Maternal Mortality Rate(MMR)	5.6/1000LB
Life Expectancy at Birth (LEB)	53.4 yrs
Fertility Rate (FR)	7.5C?W
Crude Birth Rate (CBR)	46.7/1000
Crude Death Rate (CDR)	17.9/1000

An estimated 69 to 80 percent of health problems are due to infectious and communicable diseases and nutritional problems. The health care system is underdeveloped and only able to provide basic service to about 61% of the population. Much of the rural population has little access to modern health care, that lead to the inability of the health care delivery systems to respond both quantitatively and qualitatively to the health needs of the people. Previously, the health delivery system was highly centralized; delivered in a fragmented way and relied on vertical programs and there was little collaboration between the public and private sectors. Consequently, the Ethiopian Federal Government has initiated political, economic and social changed resulting in the formulation of the 1985 health Policy and Strategy. The Federal Government and the regional authorities are trying to recognize health services into amore cost-effective and efficient system better able to contribute to the overall socio-economic development effort of the country.

The Government Health Sector Development plan is to realize its health development objective through a twenty-year health sector development strategy, with five-year rolling investment programs, with first Health Sector Development Program covering periods 1997-2001. This has been followed by the second Health Sector Development Program covering 2002-2004.

The main objective of the health service in the future is to give a comprehensive and integrated primary health care in health institutions at the community level. The approach will be to emphasize on the preventive and promotive aspect of health care without neglecting essential curative services. The focus shall be on communicable diseases, common nutritional disorders and on environmental health and hygiene. Maternal and child care, immunization, reproductive health, treatment and control of basic infectious diseases like upper respiratory tract infection and tuberculosis, control of epidemic diseases particularly AIDS receive special attention. Information, education and communication about health and nutrition shall be strengthened. Human and material resources will be developed, deployed and managed in line with these objectives.

Major Components of the health sector strategy

1) Strengthening the preventive and promotive health service
   - Community health services
   - Family health care
   - Environmental and occupational Health and safety
2) Curative and Rehabilitative care
3) Drugs and Medical Supplies
4) Health information, documentation and processing
5) Organization and management of the health delivery system.
6) Human resource development and management
7) Research and development.
8) Financing the health care delivery system

Table 4.24: Summary of Basic Health Indicators

Indicator	1997/98	1998/99	1999/00	2000/01	2001/02
Total population	57.3	57.3	59.1	61.0	61.3
PHS Coverage (%)	65.1	66.1	68.0	70.7	70.2
EPI Coverage (%)	38.4	41.9	41.9	51.5	50.4
Health Service Utilization	0.27	0.27	0.27	NA	0.29
CPR (%)	7.9	13.3	18.7	17.2	21.5
Annual Coverage (%)	25.5	29.1	34.7	34.1	27.4
Number of Facilities					
Hospitals	100	103	110	115	119
Health Centres	304	356	382	412	451
Health Stations	2268	2330	2393	2452	2396
Health Posts	1012	833	1023	1311	1432
Private Clinics	966	1119	11170	1235	1229
Pharmacies	272	304	311	311	302
Drugs Shops	243	250	249	309	299
Rural Drug Vendors	1858	1950	1917	1856	18888
Human Resources (at service)					
Physicians	1283	1263	1366	1888	2032
Health Officers	144	201	296	484	631
Nurses	5498	6713	7723	12838	14160
Health Assistants	10641	8330	7386	8149	6856
Para Medicals	1989	2201	2758	3824	4641
Human Resources (Graduate)					
Specialists	46	58	61	91	103
General Practitioners	136	152	128	152	182
Health Officers	79	157	181	183	181
Nurses	1416	1399	2164	1562	1465
Para Medicals	613	671	917	656	1054

Table 4.25: Major Health sector Development Targets (1995-1997)

Indicators	Target
Contraceptive coverage rate	24%
ANC coverage	45%
EPI coverage	70%
Coverage of TT2 to pregnant women	70%
Coverage of TT2 to non-pregnant women	32%
Post –natal service converge	20%
Proportion of deliveries assisted by trained health workers	25%
Share of the annual health budget	8.2%
Coverage of tuberculosis prevention and control service	75%
Proportion of safe and adequate water supply	42%
Proportion of the population with access to excreta disposal facilities	35%
Availability of essential drugs and medical supplies in each health facility	80%
Drugs prescribed in generic name	92%
Per capita expenditures on health	6USD
Blindness prevalence rate	0.6/10000
HIV prevalence rate	7%
EPI	10%
Defaulter rates of TB & leprosy	0%

The WHO statistics show that about 80 per cent of all diseases in the developing countries are related to unsafe water supply and inadequate sanitation, resulting in high infant mortality, low life expectancy and poor quality of life. Thus, access to safe drinking water and sanitation has proven to be essential to good health. Combined water supply, sanitation, hygienic practices and health/hygiene education are associated with greater health benefits and reduce diarrhoea incidence by 35-50 percent.

Water supply and sanitation situation in Ethiopia is inadequate. Most of the populations, urban and rural alike, do not have access to safe and adequate water supplies and sanitation facilities. Few households show sufficient understanding of environmental sanitation or hygienic practices regarding food, water and personal hygiene. As a result, three-fourths of the health problems in Ethiopia are due to communicable diseases attributable to unsafe/inadequate water supply, and unhygienic/unsanitary waste management, particularly excreta. Diarrhoeal diseases caused by improper management of water and sanitation is among the major causes of infant and child morbidity and mortality

Water and sanitation programmes have a direct bearing on the prevalence of diarrhoeal diseases in the population. Water and sanitation projects, which are properly designed and implemented, have the potential of reducing diarrhoea-caused deaths by 55 per cent. The combination of safe water supply, sanitation facilities and hygienic practices has demonstrated a potential in contributing to a remarkable mortality.

Despite the significant water resources available in the country, the status of water supply coverage is very low. The communities have poor access to supplies of safe and adequate water particularly in the rural areas. It was estimated that only 32 per cent of the total population, 80 per cent of urban population and 24 per cent of the rural population have reasonable access to adequate water supply (MoH, 1999). According to the specification of NPA (National Programme of Action for Women and Children), adequate water supply is defined as 20 litres per capita per day made available within a range of one to two kms. from the dwelling. Estimates for average per capita per day water consumption vary between 10 and 20 litres per day in some areas. However, in most rural areas of Ethiopia, depending upon seasonality and location of source and availability of water, daily

consumption is as low as 3-4 litres per capita per day. Women and children particularly girls have to fetch water, often walking for 3-8 kms from their dwellings.

The lack of sufficient quantities of clean water critically weaken the ability of most rural populations to engage in appropriate personal, food and environmental hygienic practices which could greatly assist in stemming the tide of infectious diseases. The inaccessibility of protected, improved water supplies to about 80 per cent of the rural population and 20 per cent of the urban dwellers clearly indicates that the health and well-being of the population in general and that of women and children (make up nearly 75 per cent of the population) in particular, is at great risk to multitude of water-borne or water related disease. Although it is difficult to sufficiently quantify morbidity and mortality related to unsafe and inadequate water supply because of the lack of an effective monitoring and surveillance system and countrywide baseline survey, limited information on disease prevalence reported indicates that water-borne or water-related diseases are among the major causes of sickness and death. Among the major water related diseases, diarrhoea alone is accountable for 46 per cent of under-five child mortality. Women and children particularly girls are the main water carriers and having regular contacts with contaminated water. They are the segment of the population most vulnerable to water related diseases.

The majority of infectious diseases in developing countries are related to water in some ways. Water related diseases include those, which are carried by water or where water provides the vital link in their transmission. They also, include diseases, which can be prevented or reduced by the hygienic handling and use of water. Water also provides breeding places for insects, such as mosquitoes, which transmit malaria. Control or prevention of these diseases will mainly depend on safe disposal of all human wastes, provision of safe and adequate water, community health/hygiene education and safe socio-economic development project undertakings.

Between 20 and 30 different infective diseases may be affected by changes in water supply. Water related infections are usually classified by microorganisms causing them or by mode of spread; Examples are:

- Water-borne diseases, Infections spread through water supplies: e.g. Cholera, Typhoid, Infectious hepatitis, Poliomyelitis
- Water-washed diseases, Diseases due to lack of water for personal hygiene: e.g. skin and eye infections (Scabies, Trachoma).
- Water -based disease, Infections transmitted through an aquatic intermediate animal: e.g. Schistosomiasis.
- Water related insect vectors Infections spread by insects that depend on water: e.g. Malaria, Yellow fever, Trypanosomiasis

Data on morbidity and mortality rates due to sanitation related diseases are based mainly on reports from hospitals, health centres, and health stations since studies in these areas are insufficient. However, many diarrhoeal diseases such as Cholera, Typhoid and Hepatitis caused by poor sanitation conditions are serious threats in Ethiopia, particularly childhood diarrhoeas that are a leading cause of morbidity and mortality in children under five years. The high prevalence of intestinal parasites among the population, especially worm burdens in children is the direct results of faecal contamination of food and water.

According to the World Bank 22 diseases are related to improper disposal of solid wastes (World Bank 1999). However, national solid waste management facilities coverage is estimated at 2 per cent. Refuse disposal sites in urban areas are often insufficient and unorganised. As a result, in the urban centres including the capital city, solid wastes are not

properly stored, collected and disposed of but accumulate in drains and on open lands, thus provide breeding areas for disease vectors. Indiscriminate disposal of waste water (liquid waste) in both urban and rural settings is also common practice.

In general, the sanitation sector has met with many setbacks over past time due to varied and several reasons. Few among the many are:

- Lack of or low awareness of the communities particularly the rural about health implication of sanitation practices. Hence, insufficient or no involvement of the beneficiary communities in the sanitation scheme development and promotion.
- Lack of or insufficient government subsidy (funding) to the sanitation programme.
- Inadequate or lack of clearly defined sector policies, strategies, guidelines, standards, legislation, regulation to promote the sector services, programmes and projects.
- Lack of clearly defined indicators for monitoring and evaluation of the sector progress, effects and impacts (health, social, economic and environmental).
- Inadequate or lack of support for research and experimentation on low-cost, affordable and sustainable sanitation technology options.
- Inadequate trained personnel of various levels (technician, sub-professional, professional) in the country.
- Inadequate technology choice.

In summary, sanitation both urban and rural has not been accorded the importance in the promotion of environmental health programme in the country. It has never received the emphasis it deserves i.e. it has not been seen as a priority area of concern.

Distribution of Common Water and Sanitation Related Diseases

Major water (Water-borne, Water-based, Water-washed, Water-insect-vector related) and sanitation-attributed diseases in Ethiopia are summarized below.

Malaria

More than 50 per cent of the land in Ethiopia is below 1,500 metres. This altitude is probably the most important single factor in the distribution of many communicable diseases including malaria. About three-quarters of the total area of Ethiopia are estimated to be malarious, and about two -thirds of the inhabitants of the country are at risk of infection. The concentration of the Ethiopian population in the highlands is partly due to the widespread occurrence of malaria in the lowlands.

In warm zone (below 1,500 meters altitude, characterized by rainfall totals of 100 to 900mm and mean temperature of 200 to 30 0c), malaria is moderately to highly endemic. In this zone are the highly mlarious areas of Setit Humera, Metema, Metekel, Gambela, Gode and Awash Valley. In the temperate zone (between 1,500 and 2,500m where mean annual rainfall is 400 to 2,400mm and mean temperature 200c), malaria does occur, but most in areas below 2,000m attitude. In this zone malaria is usually of low endemicity and very unstable, with frequent outbreaks resulting in high morbidity and mortality due to lack of exposure –related communal immunity. The cold zone (above 2,500 altitudes, with mean annual rainfall from 1,000 to 1,600mm and mean annual temperature of 150c) is free of malaria, and there are no records of indigenous transmission.

Malaria remains a major public health and economic problem in the Ethiopian lowlands. It is one of the water related insect vector-borne diseases. Its prevention and control would depend on the vigilant selection of sites, and design, construction and maintenance of water resources development projects and irrigation schemes. Proper maintenance and vicinity sanitation of water points are also of utmost importance to curb the occurrence of malaria in Ethiopia.

Yellow Fever

A serological survey carried out by WHO in 1955 in nine Administrative Regions revealed no yellow fever in Ethiopians. Ethiopia was nevertheless retained in the list of African countries yellow fever because geography and climate favour the disease, and because previous entomological studies have confirmed the presence of the probable vectors (Aedes spp) at elevations below 2,000m.

The epidemic of yellow fever in western and south-western Ethiopia between 1959 and 1962 contributed to the most devastating outbreaks of yellow fever in Africa in regard to mortality. The first cases of yellow fever were reported in the second half of 1959 in Benshangul Gumuz Region. The outbreak centred on the lowlands between Assosa and Kurmuk towns. A much more serious yellow fever epidemic started in the lower Omo Valley near Dime in Gamo Gofa at the end of 1960. This epidemic affected an area of 100,000 Square kilometres with a total population of about one million. In general, most cases were reported from Gamo Gofa, Kefa and Sidamo, and a few from Didesa river valley in Wolega. The last yellow fever outbreak reported was in the early part of the 1966 near the northwestern shore of Lake Abaya in Gamo Gofa and round the town of Akobo in Gambela. Since then there have been no officially reported and confirmed cases of yellow fever in Ethiopia.

Typhus

Louse-borne Typhus is common cause of acute febrile illness throughout Ethiopia and especially in the highlands. It appears to have existed in the country for centuries, but the first epidemic was reported in 1866, in army camps and prisons. Numerous local epidemics have been reported since the 1940s from Ethiopian prisons, refugee camps, relief shelter and rural areas.

Tick-borne typhus is believed to occur in both the highlands and lowlands of Ethiopia. There is no documentation about flea-borne Typhus, which is caused by Rickettsia and transmitted from rat to man by a variety of lice, mites and fleas, especially the rat flea (Xenopsyla cheopis).

Typhus is a serious health problem in Ethiopia. The proportion of the vectors and the transmission of Typhus are facilitated by persisting poverty, famine, lack of adequate hygiene, extensive population movements. It should be emphasized that for effective prevention there need to be better hygiene, housing conditions, socio-economic standards, and improvement of health services.

Relapsing Fever

Louse-borne relapsing fever is caused by spirochetes (Borrelia recurrentis). Relapsing fever is established in the highlands of Ethiopia. Disproportionately more cases have been reported from the Ethiopian highlands than the lowlands. Most cases are normally reported during the cool season (August to December). Epidemics of relapsing fever have traditionally been associated with crowded army camps, crowded prisons and relief camps.

It is, like typhus, a classic example of an illness that is associated with war, malnutrition, crowding and poor hygiene. Relapsing fever is endemic with limited epidemics in the country. Several thousand cases were reported annually to the Ministry of Health between 1981 and 1990 with the largest number in 1983, when an epidemic occurred in Wolayita Zone. Between one-quarter and one-half of all cases reported annually between 1987 and 1990 were reported in Wollo (1987), Shewa (1988/89) and Gonder (1990). Another 10-15 per cent of the cases were reported annually from health facilities in Addis Ababa. Relapsing fever has rapidly spread and caused high mortality rates in Ethiopia during wars, civil unrests and famines. Epidemics were reported from army camps and among displaced persons. In many ways the disease is associated with crowdedness, thus, transmission would be unlikely if people were housed adequately and were not sleeping crowded together. Tick-borne relapsing fever has not occurred and reported in Ethiopia.

Tapeworm (Taeniasis)

Tapeworm (Tainia saginata) is the most important human intestinal helminthic disease in Ethiopia. It is acquired by raw or under-cooked meat. High infection rates in Ethiopia are due to the widespread custom of eating raw beef, and the habit of defecting in open fields coupled with the tradition of allowing cattle to graze in such fields. Another common tapeworm in Ethiopia is the small or dwarf tapeworm, Hymenolepsis nana, transmitted in the faeces of infected persons. It is most common in children and is easily transmitted from person to person through faecal oral route.

Ascariasis

Ascariasis is intestinal helminthic diseases. It is one of the commonest and most widespread human parasites in the world. This parasite is most common in least developed countries, is estimated to infect a quarter of the world's population. Ascaris is found in practically every Ethiopian community and is probably the most common communicable diseases in the country, particularly in the highlands.

Hookworm

Hookworm infections in Ethiopia are most widespread in the 800-1200m altitudinal zone and the humid western lowlands at even lower elevations, where moisture is assured through most of the year and where the average temperature of the coldest month is above 180C. Some of the highest infection rates, between 50 per cent and 30 per cent were found in the lowlands of Illubabur, Kefa and Wolega. Other helminthic diseases of public health importance include Trichuriasis (Whipworm), Strongyloidiasis, and Enterobiasis (Pinworm). The high prevalence of most intestinal parasites in Ethiopia emphasizes the need to intensify the programmes of improved water supply, latrine construction, improved housing, and health education programmes.

Shistosomiasis

Shistosomiasis is one of the most thoroughly studied vector-borne diseases in Ethiopia. Agricultural development schemes, water resources development projects and resettlement sites are the high risk areas. Increasing population movements in recent decades and deteriorating living conditions have also facilitated the spread of shistosomiasis to areas where it was previously absent. There exist two types of helminthic parasites, Shistosomiasis mansoni (intestinal type – transmitted through feces) and Shistosomiasis haematobium (bladder type- transmitted through urine) in Ethiopia; the former is widespread in the country.

Many researchers have described the geographic distribution of S. masoni and its intermediate snail hosts in Ethiopia. The snail host, which prefers small streams and irrigation canals, is by far the most common in the country. About 90 percent of the known endemic communities are villages and small towns by small rivers and streams at intermediate altitude between 1,300 and 2,000m. The greatest concentrations of high prevalence communities are in Lakes Tana, Zway, Abaya and Chamo, and in the irrigation schemes in the upper part of the Awash Valley. Water resources development in the Awash Valley has been associated with the spread of shistosomiasis mansoni into areas where it had been absent or rare previous to large-scale irrigation development. The three northern regions of Tigray, Welo and Gondar are most attacked. The southern and western regions of Bale, Sidamo and Illubabor had the lowest rate. The remaining regions had intermediate rates.

The major control measures for both species would include: -

1) Provision of safe and abundant water supply for domestic purposes,
2) Construction and use of latrines,
3) Extension of primary care services, including the development of effective health education programme,
4) Strengthening of community based control activities,
5) Careful selection of site and design of irrigation schemes and adherence to regulations regarding the operation and maintenance of schemes so as to prevent snail hosts and the transmission cycle from becoming established, and
6) Follow-up treatment of newly arriving farm labourers and settlers infected with histosomiasis.

Trypanosomiasis

Human Trypanosomiasis (sleeping sickness) in Ethiopia is caused by the protozoan parasite, Trypanonoma brucei rhodensiens. The vectors, tsetse flies of genus Glossina are responsible for the cyclical transmission of the disease. The first of human Trypanosomiasis in Ethiopia was reported in 1967, but a major outbreak of the disease was not recorded until the 1969 – 70 epidemics. The general area of the 1969 epidamc in Gambela is lowland and is essentially an eastern continuation of the Sudan plains. The other reported foci in Gambela are rivers of Baro, Gilo, Pokwo, Ariet and Akobo. The areas along these rivers were associated with most of the diagnosed infections and outbreaks. Sporadic cases have also been reported from Mursi –Bodi district in Gamo Gofa, and the focus was believed to be associated with the river Maro, a tributary of the Omo, and from Maji in Kefa, and settlement areas in the Anger-Didesa valley in Wolega.

The distribution of animal trypanosomiasis of various species, unlike the limited distribution of human trypanosomiasis and its vectors, is over larger areas of the country (Illubabor, Gamo Gofa, Gojam, Kefa, Shewa, Sidamo, Wolega and Welo). It is estimated that an approximate area of 98, 000 sq. kms is infested by the tsetse fly vectors. Animal Trypanosomiasis has a great economic impact in Ethiopia since the country's economy is mainly based on agriculture and animal husbandry. The major control measures of the disease and its vectors would depend upon the environmental manipulation and management, particularly among the water basins, the vectors' main habitats.

Trachoma

Trachoma is one of the common eye diseases in Ethiopia. Trachoma – associated lesion are major causes of blindness in the country. Most of the trachoma blindness occurs in rural areas, where multiple factors such as illiteracy, poverty, overcrowding and low health services prevail. An epidemiological study of trachoma in a rural highland community in Gondar showed hyperendemicity. This study also reported that there were significantly lower prevalence rates in those who washed their faces regularly than in those who did not, and among educated than illiterate persons. This indicates that the abundance of water for personal and environmental hygiene and sanitation is one of the major measures for reducing water-washed diseases such as trachoma.

Amoebiasis and Giardiasis

Amoebiasis and Giardiasis are two important parasitic diseases in Ethiopia. Transmission of these intestinal parasites takes place through fecally contaminated water and food, but occasionally through intimate contact. These intestinal parasites are widespread in Ethiopia largely due to poverty, low level of environmental sanitation, lack of safe drinking water to the population and ignorance of simple health promotion practices. Thus, the availability of safe drinking water together with the improvements in relatively neglected areas of housing, environmental sanitation, fly control and personal hygiene may hold promise for the reduction in the prevalence of these diseases both in urban and rural settings.

Onchocerciasis

The occurrence of the vector (black files) and the disease (human Onchocerciasis) in Ethiopia was first reported by Italian investigators who worked in South-western Ethiopia in 1939 and 1940, respectively. Post investigations have established that Onchocerciasis is indeed endemic, particularly in Illubabor, Kefa and Wolega in the main river valleys. Further studies have confirmed the endemicity of the disease in Gamo Gofa, and also have located foci along major river basins in the Angereb valleys in Gondar.

The black flies (Simulium domnosum complex) are believed to be responsible for the transmission of Onchocerciasis in the main river valley in the southern Ethiopia. The characteristically fast flowing and shaded rivers and streams in the forests and tree-fringed savannas of west Ethiopia provide suitable habitat for the vectors. About a dozen Simulium species have been distributed in all regions of Ethiopia.

Acute Childhood Diarrhoea (ACD)

Acute infectious diarrhoea occurs in children under five years of age. This symptom complex is defined by WHO as the acute onset of three or more loose of one watery stool over 24-hour period, caused by a wide range of infectious agents. In Ethiopia, ACD is consistently reported from the health institutions (health centre and health station) to be the first or second leading cause of morbidity in children. It is also the leading cause of death in children under 5 years of age and accounts for nearly half of all deaths occurring in children under 5 years of age. One of the primary preventive measures of the ACD rests upon improvements in the access, use and maintenance of safe drinking water and proper sanitation. Nevertheless, the vast majorities of Ethiopian children do not have access to safe drinking waters and exposed to unsafe sanitary conditions.

Table 4.26: Health Facilities

Health Facilities		1996/96	97/98	98/99	1999/00	2000/01	01/02
Number of functioning hospitals	Government	46	59	55	64	68	68
	NGO	17	17	17	17	17	18
Number of functioning health centres	Government	241	262	294	344	369	384
	NGO	5	5	6	23	17	26
Number of functioning health stations	Government	2202	2173	2118	2031	2019	2019
	NGO	13	14	15	268	374	312
Number of functioning health posts	Government	76	164	373	893	1063	1193
Number of health facilities per100,000 population		4.5	4.5	4.5	5.7	6	6

Source: Ministry of Health, Health Sector Development Program (HSDP2002/02-2004/05)

Table 4.27: Percentage Distribution of Household by Distance to the Nearest Health Canter

Descriptions	Distance in KM to the nearest Health Service											
KM	0-4			5-9			10-14			15 and over		
Year	1996	1998	2000	1996	1998	2000	1996	1998	2000	1996	1998	2000
National	36.2	37.5	40.1	30.3	29.4	31	13.5	15..3	15	20	17.8	13.9
Rural	25.7	27.5	31	34.9	33.9	35.3	15.9	17.8	17.6	23.5	20.8	16.2
Urban	95	98.1	94.2	4.8	1.7	5.2	0	0.1	0.1	0.2	0.1	0.5

Source: CSA 2000

Table 4.28: Health Indicators

Year European	under 5 Mortality	Maternal Mortality rate	Birth attended by Trained personnel (In percent)
1992/93			8
1993/94	159	1400	6
1995/96	161		
1996/97	161		10
1997/98	161		8.4
1998/99	161		7.8
1999/00	161		8.7
2000/01	140		9.9
2001/02	187	871	9.7

Table 4.29: National Top 10 leading Causes of Deaths, 2002

Rank	Diagnosis	Cases	%
1	All types of Malaria	1204	27
2	All types of TB	511	11.5
3	Bronchopneumonia	278	6.2
4	Primary atypical, other and unspecified pneumonia	194	4.4
5	Tetanus	101	2.3
6	Relapsing Fever	42	0.9
7	Lobar pneumonia	89	2.0
8	Dysentery	82	1.8
9	Hypertension without mention of heart	90	2.0
10	Pyrexia of unknown origin (Fever)	68	1.5
Total of 10 leading causes		2659	59.6
Total of all diseases		4459	100

4.3.9 Water Quality Standards and Effectiveness

National Drinking Water quality guideline was developed by Ministry of Water Resources in the year 2000 under the financial support of UNDP. The National Drinking Water quality guideline is now at the stage of it's testing to be transformed to a National Standard.

The major prevalent water quality problems in Ethiopia are those related to physical, chemical, as well as microbiological parameters, the possible causes of which are natural, anthropogenic or both. Some of the major water quality problems shown below on table. 4.30

Table 4.30: Water Quality Problems in Ethiopia

No.	Water quality problems	Parameters of concern
1	Physical parameters	colour, odour, Turbidity, Taste
2	Chemical Qualities	iron, hardness, pH, Nitrate, Fluoride, sulfate, Nitrite, Manganese, CO2,TDS
3	Microbiological	Total coliforms, E.coli, giardia, Amoebae.

The most significant of all the water quality problems is poor microbiological and biological water quality. Most of the ten-top diseases, which affect public health, are the result of water borne and water related diseases.

The possible sources of the main prevalent water quality problems result either due to natural causes (geological or soil formation of an area or due to anthropogenic activities (domestic, industrial, commercial, agricultural. etc) and /or a combination of both.

4.4. Water Sector Reform

4.4.1 Major Achievements of the Water Supply and Sanitation Sector

Prior to 1993, the then established water related institutions carried out implementation of various scaled water resources projects directly from the centre. After the decentralization process of 1993, all regional governments established & designated Water Resource Development Bureau. And further decentralization took place to "Woreda" (2nd smallest unit of administration) level. The Regional governments own and take full responsibilities for supplying potable water for urban centres and rural areas at well.

The Ministry of Water Resources (MoWR) was established by proclamation No.4/1995.The MoWR is the overall authority for the WSS sector. The powers and duties of MoWR are described as follows in proclamation 4/95.

- Determine the condition and methods required for the optimum allocation and utilization of water that flows across or lies between more than one regions:
- Prepare draft laws concerning the protection and utilization of water resources;
- Issue permits to construct and operate water works relating to waters referred to in sub-article (1) of this Article; and regulate same:
- Make appropriate studies concerning water tariff and, upon approval, collect bulk charges for water use under sub-article (1) of this Article:
- Undertake studies pertaining to the utilization of the waters of trans-boundary rivers and, upon approval, follow up the implementation of same;
- Prepare plans that help the properly utilization of water resources for development purposes and supervise their implementation upon approval;
- Provide all the assistance deemed necessary with regard to water resources development;
- Sign intentional agreements relating to trans-boundary rivers, in accordance with the law;
- In cooperation with the appropriate organs, prescribe the quality standards for waters to be used for various purposes;
- Supervise for proper rendering of meteorological services.

Currently there are also institutions affiliated to the Ministry of Water Resources, The Meteorological service Agency, Awash Basin Water Resource Management Agency and specialized public enterprises engaged in study, design, supervision and construction of water related activities like Water Works Design and Supervision Enterprise and the Water resource development fund.

Private consulting firms are also growing up in the water sector. They have started working with foreign firms in association as well as they are taking responsibility separately. Their scopes of work include study, design and supervision. There are also public and private construction companies.

The Urban Water Supply Utilities are mostly accountable to the regional water resource development Bureaus, however after a study conducted with the assistance of the world Bank, it has been agreed by most of the regions to establish autonomies water utilities. The management of the utilities will be accountable to respective Boards, to be designated and shall have legal status.

As it is always mentioned and briefly presented above, Ethiopia has abundant land and water resources. However, the level of utilization todate is below the needs of any of the people. The following short summary presents the existing situation in the water supply and Sanitation sub sector.

Both urban and rural water supply and sewerage coverage in Ethiopia are low. Various sources of information cite figures for water supply coverage but often differ because data are not accurately recorded. According to the MoWR source in 2000, access for urban water supply was 72 per cent and that of rural areas was 24 per cent while the national

coverage was only about 31%. Sanitation coverage is in a worse condition in that even the large cities lack proper services. The national coverage is believed to be only about 17%. Regional variation is insignificant except that of the two city state, Harai and Dire Dawa.

Table 4.31: Per capita water consumption (L/c/d) based on the information gathered from 208 towns is summarized here under.

Variants	towns with population>10,000	towns with population 10,000-30,000	National
Minimum	6.04	0.00	0.00
Maximum	30.79	19.5	30.79
Mean	14.77	5.63	6.34
Median	13.35	4.88	5.15

The National Water management Policy

The Government issued the Ethiopian Water resource management policy in 1999. The main goal of the policy is to enhance and promote all national efforts towards the efficient, equitable and optimum utilization of the available water resources of the country for significant socio-economic development on sustainable basis.

The fundamental principles of the Ethiopian Water resource management policy are:-

- Water is a natural endowment commonly owned by all the people of Ethiopia.
- Every Ethiopian citizen shall have access to sufficient water of acceptable quality, to satisfy basic human needs.
- Water shall be recognized both as an economic and a social good.
- Water resource development shall be underpinned on rural-centered, decentralized management, participatory approach as well as integrated framework.
- Management of water resource shall ensure social equity economic efficiency, systems reliability and sustainability norms.
- Promotion of the participation of all stakeholders, user communities specially that of women's participation.

The policy is developed giving due attention both for general, cross cutting and Sectoral issues. Inland water transportation, aquatic resources and tourism and recreation have been addressed under general policy.

The issue of water allocation and apportionment, environment, watershed management, water resources protection and conservation, technology and engineering, water resources management information systems, monitoring, assessment and auditing, water cost and pricing (economics of water), ground water resources, disasters, emergencies and public safety, trans-boundary water stakeholders, gender, research and development, water quality management and enabling environment have been dealt under the umbrella of cross cutting issues.

The Sectoral part of the policy has incorporated specific issues on the area of water supply and sanitation, irrigation and hydropower.

All the issues addressed in the policy are equally important. However, the issue of Basin development approach, integration of developments, water pricing, cost recovery, community empowerment, and equitable utilization of resources could be taken as pillars for future development. and management of water resources.

The National Water Strategy

Ethiopian Water Sector Strategy is taken as an instrument to translate the Ethiopian Water Resources Management Policy into action. The strategy provides, the framework, which contains ways and means of attaining the intended objectives. The goals and guiding principles will remain the same with that of the policy.

The objective of the strategy is to translate the national policy into action. To make it more specific, it sets the road map as how to make meaningful contribution towards

- Improving the living standard and general socio-economic well being of the Ethiopian people.
- Realizing food self-sufficiency and food security.
- Extending water supply and sanitation coverage to large segments of the society.
- Generating additional hydropower.
- Enhancing the contribution of water resources in attaining national development priorities.
- Promoting the principles of integrated water resources management.

In order to elaborate the strategy it is carefully divided into four sub-sectors, which are general water resource, the water supply and sanitation, irrigation and hydropower strategy.

Water Sector Development Program.

Following the issuance of the Policy and development of strategy the MoWR entered in to the preparation of the Water Sector Development Program. The document is currently ready. The entire preparation process took almost 2.5 years and was completed in June 2002..

The preparation process of the WSDP was consultative where beneficiaries and all relevant stakeholders at all levels were informed and participated. .

Partners have expressed their view, specially, on the growth scenario and targets to be reached after fifteen years. The implementation strategy and possible institutional arrangement were also discussed thoroughly. The experience of other sector development program has been reviewed. The most important framework of the development program has been identified and the target was also set. The following are the guiding principles adopted for the preparation of the WSDP;

- Be consistent with the national water management policy and the national water strategy.
- Be in line with the national economic development strategy, and relevant to the socio economic development of Ethiopia.
- Promote sustainable development and management of water resources.

- Account the "Basin" as a planning unit for development and management of water resources.
- Incorporate linkages with the on-going and planned projects.

It is clear that, the country has enormous demand regardless of the financial and capacity limitation. However, taking into account both the financial and capacity limitation the WSDP has adopted the following water resource development priorities.

- Making clean drinking water available to the larger segments of the society, including water for sewerage purpose.
- Making water available for livestock in critical areas such as the nomadic areas.
- Expanding irrigated agriculture to the maximum possible extent.
- Meeting hydropower generation capacity needs arising from electricity demand in the economic and social sectors.
- Providing water for the industrial development.

Within the overall priority provided above, highest priority has been given to the programs and projects, which are;

- On going and their implementation is expected to continue during the plan period.
- Require rehabilitation and reactivation.
- Were started, but for some reasons their implementation was discontinued.
- Have already been subject to appraisal and are already being considered for possible funding.
- Have been identified in master plan studies.
- Considered for capacity building.
- Are indicated in the Nile Basin Initiative and the Eastern Nile Subsidiary Action program.

Population forecast at different scenario and setting a target, screening, evaluation and ranking of projects was also carried out to be identifying more worthy projects and programs. The development program is divided into three, which is short term (2002-2006), medium term (2007-2011) and long term (2012-2016).

Water Resources Development Fund

The establishment of the Water Resources Development Fund is taken as a fundamental move towards improving the water resources management of the country, by attempting to avail among the most important resources by mobilizing it form domestic and external sources.

The proclamation for the Establishment of the Water resources Development Fund and its Administration describes the objectives of the Fund as:

- To promote self sufficiency in the provision of reliable and sustainable water supply and sanitation
- To make a contribution towards attaining food self sufficiency by expanding irrigation development by the provision of loans to these sectors on the basis of cost recovery.

The sources of the Fund will be: foreign bi-lateral and multi lateral grants, loans and the government allocation of budget.

It is clear from the above that the Fund is therefore the institution that will be instrumental in carrying out the Water Sector Development Programme prepared and other national programmes that would fall within the framework of the national strategy.

Ethiopian Water Resources Management Proclamation

The Ethiopian Water Resources Management Proclamation No. 197/2000 has entered into force on March 9, 2000. The stated purpose of the proclamation is "to ensure that the water resources of the country are protected and deployed for the highest social and economic benefits of the people of Ethiopia; to follow up and supervise that they are duly conserved; to ensure that harmful effects of water are prevented; and that the management of water resources are carried out properly."

As regards ownership of water resources of the country, it is provided, consistent with the Constitutional provision, that they are the common property of the Ethiopian people and the State. Actually, this implies that the State will play a major role in the management, allocation, utilization and protection of the water resources of the country.

The Ethiopian Water Resources management proclamation is designed to serve as the basic legislative framework of the country with respect to the management, planning, utilisation and protection of water resources

4.4.2 Major Problems and Constraints in Water Supply and Sanitation Development and Services

Although efforts were made and still are being made to enhance the development of the sector both at the Federal and Regional Levels, there remains a lot to be done. In general, our past performances, viewed in terms of the socio-economic requirements of the people, are not satisfactory. Here are summary of the major constraints for easy and quick reference.

- Institutional Instability: - the water sector institutions were marked by frequent restructuring and re-organization. This situation produced uncertainties and made institutional capacity building difficult.
- Management Problems: - Management problems are typically explained by inefficient organizational structure, understaffing, under equipping, lack of organizational units at the lowest possible levels like woredas and zones to cater the needs of the sector, absence of career paths for staff, low and irregular salaries, lack of staff motivation, and inability to retain trained & experienced staff.
- Lack of Linkages:- Various stakeholders are involved in the water sector activities. The major ones being the Ministry of Water Resources, the Regional Water Bureaus, Non Government organizations, the community and the private sector. However, there is no structural and coordinated linkage among them, even between the two key institutions, i.e. Ministry of Water Resources and the Regional Water Bureaus.
- Lack of coordination among the institutions involved in water and water related activities could lead to inability to achieve the goal of the sector.
- Problem of Capacity: - Shortage of skilled manpower is the critical issue of all sector institutions. Every regional government has identified this constraint as most limiting to

the fulfilment of its five years plan. Moreover, inadequate office and shop facilities, insufficient vehicles and enabling environment are also some of the elements of capacity problem.

- Limited Funds/budget: - Water sector development projects by their nature require high level of investment. Lack of sufficient funding has imposed limits on the quantity and quality of outputs & services of the sector. Moreover, lack of effective cost recovery mechanisms often inhabit the ability of institutions sustain themselves and fulfil their mandates.
- Lack of integrated information Management System: - Water Sector institutions generate and utilize a wide range of data. In spite of this, the sector lacks a centralized and integrated information management system. On top of this, there is a considerable weakness at all levels of the regional water sector institutions in keeping proper records of data and information. There is also a lack of standard procedures for gathering and storing of data and information.
- Weakness in operation and Maintenance of schemes: - Generally speaking there are considerable drawbacks in managing, operating and maintenance of the existing water sector facilities, especially in rural areas. It is identified that several water supply and sanitation services are not functional in almost all of the regions. In summary, compared to scheme design and construction, operation and maintenance usually has a low profile. On top of this, operation and maintenance units are under funded compared to construction units, and lack adequate equipment, training and transport facilities to properly perform their activities.
- Absence of standards for equipments:- Several non government organizations (NGOs) participate in constructing and developing water supply schemes mainly for the rural communities. These NGOs bring numerous types of pumps and generators in the projects undertaken by them. In the process of operation, when the equipments fail to function obtaining spare parts is getting difficult. Hence, setting standards in the types of equipments to be used in water sector projects that will be undertaken by NGOs appears to be necessary.
- Low Community Participation: -Community participation in project identification, construction, operation and maintenance of schemes is low. For water sector development activities to be effective, obtain adequate commitment from stakeholders, and securing socially acceptable action, participatory and consultative approaches need to be adhered.
- Moreover, the lines of responsibility between the MoWR and health and sanitation agencies at federal level and at regional level between bureaus of water resources, urban water supply services, municipalities and health bureaus, with regard to sanitation services are overlapping and unclear.
- Standardization:- in the regions where several NGOs are operating, they bring different types of pumps and generators, and getting spare parts for these equipments have been reported as very problematic due to lack of standardization.
- Insufficient pubic private partnerships
- Low water use efficiencies in all water consuming sectors.

4.5. Policy and Guidelines

4.5.1 Water Supply and Sanitation Policy

The policies relevant to Water Supply and sanitation sub-sectors prepared and under implementation at this time by concerned ministries are the followings: -

- Water resources management policy- Water Supply and Sanitation policy
- Environmental protection policy
- Health –Environmental hygiene policies

OVERALL OBJECTIVES OF WATER SUPPLY AND SANITATION POLICY

The overall objective of water supply and sanitation policy is as stipulated in the Federal Democratic Republic of Ethiopia Water Resources Management Policy is to enhance the well-being and productivity of the Ethiopian people through provision of adequate, reliable and clean water supply and sanitation services and to foster its tangible contribution to the economy by providing water supply services that meet the livestock, industry and other water users demands.

SANITATION POLICY

- Define and implement acceptable minimum sanitation facilities differentiated in urban and rural scenarios.
- Develop a collaborative and co-operative framework for the development of sanitation system through definition of the responsibilities of the different governmental and other major stakeholder in sanitation at all levels.
- Develop and promote guidelines, rules and regulation, for the study, design, operation and maintenance for efficient, appropriate and sustainable sanitation services as well as foster appropriate water saving sanitation services and utilisation norms.
- Foster culturally and socially acceptable method and facilities for sanitation.
- Promote the formulation of a housing construction and urban development policy that incorporates sanitation services.
- Promote the involvement of non-governmental organisation, external support agencies and the private sector in sustainable sanitation programs.
- Develop standards for different types and levels of sanitation systems including both on site and off site, non-water dependent and water dependent systems.
- Promote research and development on low cost and suitable sanitation alternatives and enhance users participation in the development of sanitation systems.
- Manage the import of wastewater treatment technologies and materials through pertinent institutions.
- Build capacity in terms of engineering, design, construction, operation and maintenance … etc. Of sanitation systems.
- Promote that sanitation services are based on participation driven and responsive principles without compromising social equity.

ENVIRONMENTAL POLICY

The overall policy goal is to improve and enhance the health and quality of life of all Ethiopians and to promote sustainable social and economic development through the sound management and use of natural, human-made and cultural resources and the environment as a whole so as to meet the needs of the present generation without compromising the ability of future generations to meet their own needs.

In the sectoral environmental policies Human settlement, urban Environment and Environmental Health are included the followings: -

- To ensure that improved environmental sanitation be placed highest on the federal and regional agenda for achieving sustainable urban development;
- To promote the construction by individual families of their own houses and create conducive conditions for communities and individual families to make improvements to their immediate habitats as well as to provide human and domestic waste disposal facilities;
- To recognise the importance of and help bring about behavioural change through education and public awareness of environmental sanitation problems in trying to achieve demand driven community led sustainable use and maintenance of sanitation facilities;
- To bring about a sound partnership between the government and communities in the development of an integrated sanitation delivery system, and to the supplementary role of NGOs;
- To ensure that housing and sanitation technologies and regulatory standards are set at a level and cost that are within reach of the users and flexible enough to be adaptable to the very varied socio-economic, epidemiological, climatic and physical site conditions which are found in urban areas.
- To give priority to waste collection services and to its safe disposal;
- On the one hand to recognise the importance of adequate water supply as an important component in achieving a sustainable and healthy urban environment, and on the other hand to recognise the minimisation of the need for water as and important factor in the choice of sanitation technologies;
- To construct shared VIP latrines in the low income and very high density housing areas of Addis Ababa and the older towns with frequent emptying by tankers integrated with programmes on user education, health and hygiene, with follow up maintenance and cleaning, all implemented as a component of a broader urban environmental upgrading programme including storm water drainage;
- To ensure the construction of family latrines in lower density urban and peri-urban areas as a conditionality of the house plot lease and to integrate this with health and hygiene awareness programmes
- To create conducive conditions for families, housing groups and communities to construct latrines and private entrepreneurs to undertake latrine emptying as well as waste collection and disposal services.
- To undertake studies which identify suitable sanitary landfill sites in the major cites and towns of Ethiopia.

- To establish safe limits for the location of sanitary landfill sites in the vicinity of wells, bore holes and dams, and issue regulations to enforce them;

4.5.2 Health Policy

There was no health policy up through the 1950's; however, in early 1960s, a health policy initiated by the world Health Organization was adopted. In mid 1970s, during the Military regime, an elaborate health policy with emphasis on diseases prevention and control was formulated. This policy gave priority to rural areas and advocated community involvement. At present, the government health policy takes into account population dynamics, food availability, acceptable living conditions and other requisites essential for health improvements. The present health policy arises from the fundamental principle that health constitutes physical, mental and social well-being for the enjoyment of life and for optimal productivity. to realize this objectives, the government has established the Health sector development Program, which incorporates a 20 years health development strategy through a series of 5-years investment programs. This program call for the democratization and decentralization of health services, development of preventable health care, capacity building within the heath service system, equitable access to heath services, self reliance, promotion of intersectoral activities and participation of the private sector, including non-governmental organizations and cooperation and collaboration with all countries in general and neighbouring countries ain particular and between regional and international organizations.

Thus the health policy was issued by the then Transitional Government of Ethiopia in September 1993. This policy gives emphasis on the preventive aspect of health services. Strategies adopted to meet environmental health service needs include:

Accelerating the provision of safe and adequate water supply for urban and rural populations

Developing safe disposal of human, household, agricultural and industrial wastes, and encouraging recycling

Developing measures to improve the quality of housing and work premises for health

Encouraging the awareness and development of health primitive life-style and attention to personal hygiene and healthy environment

Health Policy – Hygiene and Environmental Health Policy Objectives are

1) To promote proper waste management system with regard to the collection, transportation and disposal of any domestic, commercial, agricultural, industrial and mining wastes including hazardous, liquid, solid, infectious and radioactive wastes.
2) Establish community based hygiene education promotion.
3) Advocate and promote the availability of excreta disposal facilities at household level and develop a latrine culture.
4) Ensure sound and effective waste management system, (collection, storage, transport and disposal).

4.6. Costs and Investments

4.6.1 Cost and Tariffs

For a long time except for urban water supply, water tariffs have not been charged for rural water supply services. Providing potable water supply to communities' costs money. Some communities can afford to pay, while others cannot. All urban dwellers pay water tariff for the potable water they consume. But the water tariffs are different for many urban centres and could also be different within the same town.

The principle that advocates that the "user must pay" for potable water has to consider the willingness and affordability of the communities that get the water services and at the same time the cost of the water schemes.

The Water Policy has provided guidance that tariff structures in water supply systems should be based on equitable and practical guidelines and criteria, that they should be site specific and determined according to local circumstances. The Water Policy states that rural tariff settings should be based on the objectives of recovering operation and maintenance costs, while urban tariff structures should be based on the basis of full cost recovery. It directs also that tariff in urban water supplies needs to be progressive and tied to consumption rates, while flat rate tariffs should be developed for communal services.

4.6.2 Investment Plan

The total investment requirement estimated by the water sector development program is US$ 2,935.8 million. Region wise investment requirement over different planning horizons are shown on the table 4.32..

From the total investment requirement

Rural water supply accounts	-US$2,086 million	71% of the total
Urban Water supply accounts	-US$819 million	28% of the total
Urban sewerage accounts	-US$30 million	1.1 % of the total

Table 4.32: Water Supply and Sewerage Development investment schedule (in Million USD)

Region	short Term				Medium Term				Long Term				Grand Total
	UWS	RWS	US	Total	UWS	RWS	US	Total	UWS	RWS	US	Total	
Addis Ababa	182.97			182.97	224.55			224.55	140.25			140.25	547.77
Afar	9.50	13.37	6.40	29.27	5.77	23.23	0.88	29.88	4.28	32.55	0.94	37.77	96.92
Amahara	36.05	127.69	0.33	164.07	13.36	144.52	0.65	158.53	9.06	164.04	0.68	173.78	496.36
Benshangul Gumuz	4.92	1.68	0.31	6.91	2.22	1.91	0.65	4.78	1.43	2.05	0.43	3.91	15.6
Dire Dawa	1.92	1.09	0.06	3.07	2.02	1.29	0.6	3.91	0.8	2.46		3.26	10.24
Gambella	7.12	3.84	0.05	11.01	0.50	6.95	0.28	7.73	0.60	7.95		8.55	27.29
Harari	28.5	1.02	0.08	29.60	1.00	0.72	0.39	2.11	8.77	1.04	0.08	9.89	41.60
Oromiya	31.18	185.94	0.14	217.26	49.10	246.34	1.88	297.33	4.00	296.46	1.31	301.77	816.36
Somali	3.02	49.40	1.75	54.17	4.04	92.88	2.45	99.37	0.63	104.42	0.97	106.02	259.56
SNNPR	4.66	101.09	0.68	106.43	20.00	134.37	2.73	157.10	3.67	138.43	1.4	143.50	407.03
Tigray	6.26	64.83	0.4	71.49	6.55	63.94	2.09	72.58	0.63	71.07	1.25	72.95	217.02
Total				876.25				1057.85				1001.65	2935.75
Foreign Cost				630.90				761.65				721.19	2113.74
Local Cost				245.35				296.20				280.46	822.01

4.7 Indicator for Challenge Area Water for Basic Needs and Health

Status of Indicators Starting from 1990-2004

N0.	Indicators	UNIT	1990-95	96-2000	2001-2004
	WATER SUPPLY				
	Demography-population				
	Mortality	10000			871
	Crude Death Rate	CRD/1000	14.96	39.9	39.9
	Mortality				
	Morbidity				
	Growth rate (Medium National)	%	2.92	3.05	2.84
	Migration				
	Density of population				
	Access to Water				
	Rural Population with access to potable water	%	15	14	23.1
	Pastoralist Population with access to potable water				
	Settled rural Population served with potable water				
	Urban population with access to potable water	%		81	74.4
	National, access to potable water	%			31
	Water Consumption				
	Urban Per capita water Consumption				
	Rural Per capita water Consumption				
	Per capita water Consumption				
	Domestic Consumption				
	Public Consumption				
	Industrial Consumption				
	Animal demand				
	Water Services level				
	Urban service level				
	Number of House connection				
	Number of Yard connection –yard private				
	Number of Yard shared connection				
	Number of Public fountain/tap				
	Percent of Vendors services users				

N0.	Indicators	UNIT	1990-95	96-2000	2001-2004
	Percentage of Traditional source users/unserved population				
	Piped Connection				
	Unaccounted for Water				
	Rural service level				
	Number of Public stand point				
	Number of Cloth washing pad				
	Number of Animal trough				
	Distance to the nearest Water source/water fetching distance, in km.				
	Number of users per type of rural water source				
	Functional Schemes				
	Non-Functional Schemes				
	Cost of Water				
	Hours per day services				
	Frequency of system beak down				
	Cost/ Revenue ratio				
	Staff-customer ratio				
	Operational and Maintenance cost to total operational cost				
	Time spent collection of water				
	Cost recovery				
	Rural and urban water tariff level				
	Unit cost of production				
	Percentage of bill collection				
	SANITATION/SEWERAGE				
	Access to Sanitation /Coverage				
	Urban Household with access to sanitation	%	57	67.7	71.6
	Rural Household with access to sanitation	%	6	8	8.9
	National Household with access to sanitation	%	13	18	
	Population connected to sewer line/sewerage				
	Volume of waste water generated				
	Volume sludge/septic tank or pit latrines content generated , collected and disposed properly				
	Population served by sanitation				

N0.	Indicators	UNIT	1990-95	96-2000	2001-2004
	facilitates				
	Private pit latrines (dry or wet)				
	Shared pit latrine				
	Private flush toilet				
	Shared flush toilet				
	Open defecation				
	Population served by Bathing facilities				
	Bath tap private	%	1.5		
	Bath tap shared	%	0.2		
	Shower private	%	2.2		
	Shower shared	%	0.8		
	without bathing facilities	%	93.6		
	WATER AND HEALTH				
	Health and Diseases				
	Infant mortality rate form water born diseases				
	Under 5 years mortality rate form water born disease				
	Rate of water born diseases out of the Ten top diseases				
	Morbidity rate for diarrheal diseases and Schistosomasis and malaria.				
	Household solid waste generated, collected and disposed safely.				

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Chapter 5

5 Water and Ecosystem

5.1 Introduction

Water and Ecosystem

Ethiopia is located between 30N and 15 0N latitudes and 33oE and 48oE longitude. This coupled with the country's enormous geographical diversity makes it home to unique assemblage of natural resources. The topography is so varied that elevations range from 125 m below sea level in the Afar Dallol depression to a number of peaks in excess of 4000m, of which the highest is Ras Dejen with 4620 m.a.s.l.

The country is also characterized by a range of climatic zones. Based on the temperature and altitude, the country traditionally classified as Bereha (hot arid), Kolla (warm to hot semi-arid), Weina Dega (Warm to cool semi humid), Dega (cool to cold humid), and Wurch (cold moist temperature).

Ethiopia is also famous for its water resources. Among its river basins Abay, Tekeze, Genale-Dawa, Wabi-Shebele, Omo, Awash and Baro-Akobo are most notable with significant irrigation and power potential.

These variations in topography, climate and availability of different water bodies make the country known for different ecosystems.

Ecosystem is a collection of interdependent parts that function as a unit and involve inputs and outputs. The major parts of an ecosystem are the producers (green plants), the consumers (herbivores and carnivores), the decomposers (fungi and bacteria), and the nonliving, or abiotic, component, consisting of dead organic matter and nutrients in the soil and water. Inputs into the ecosystem are solar energy, water, oxygen, carbon dioxide, nitrogen, and other elements and compounds. Outputs from the ecosystem include water, oxygen, carbon dioxide, nutrient losses, and the heat released in cellular respiration, or heat of respiration. The major driving force is solar energy.

Ecosystem can be categorized as terrestrial, aquatic, wetland, marine etc. The following sections briefly discuss major ecosystems found in Ethiopia.

5.2 Wetland Ecosystem

Wetland is a geographic area with characteristics of both dry land and bodies of water. Wetlands typically occur in low-lying areas that receive fresh water at the edges of lakes, ponds, streams, and rivers, or salt water from tides in coastal areas protected from waves. In wetlands, the surface of the water, called the water table, is usually at, above, or just below the

land surface for enough time to restrict the growth of plants to those that are adapted to wet conditions and promote the development of soils characteristic of a wet environment. The existence of all types of wetlands, as well as many of their biological characteristics, is determined by water.

Ethiopia is a country that is better known for recurring droughts and extensive dry lands. This notion presents the impression that the country has minimal water resources not to mention its potential of providing millions of m3 of water to other neighboring countries.

On the contrary Ethiopia is rich in water resources that are exemplified by various types of wetlands. With the exception of coastal and marine-related wetlands and extensive swamp-forest complexes, all forms of wetlands are represented in Ethiopia. These include alpine formations, riverine, lacustrin, palustrine and floodplain wetlands. Flood plains are found both in Ethiopia's highlands and low lands, although they are most common in the North -Western highlands, Rift valley and Eastern high lands. Hillman and Abebe (1993) estimate that wetlands cover 1.14 % of the total landmass of the country.

Even though Ethiopia is not signatory to the convention on wetlands, a significant proportion of its wetlands qualify as wetlands of international importance. Thirty-one sites, which are important bird areas, are potential sites that could easily fulfill candidacy as wetlands of international importance.

5.2.1 Types of Wetland

Wetlands of Ethiopia can be grouped into four major categories based on ecological zones, hydrological functions, geomorphologic formations and climatic conditions (Yilma D.Abebe and kim Geheb, 2003). These categories interlink to form four major biomes, which also describe climatic conditions in Ethiopia. These biomes are the Afro-tropical highlands, the Somali Masai, the Sudan-guinea and the Sahelian Transition Zone groups (Tilahun et al., 1996).

5.2.1.1 The Afro-Tropical Wetland System

The Afro-Tropical Highlands are composed of the Central, Western and Eastern Highlands of Ethiopia that serve as the prime water catchments and sources of its major rivers. The average annual rainfall is more than 2000 mm. Rains are bimodal, with the long rains extending from June to September and short rains between February and May (Tlahun et al, 1996). These areas include most of Ethiopia's alpine and fresh water wetland ecosystems. The wetlands in this biome include Lakes Tana, Hayk, Ashange, Wonchi and, in the Western high lands, Gojjeb and Ghibe. Flood plains associated with the biome's lakes and rivers are the Fogera and Dembia on the shores of Lake Tana. Some of the important wetlands of the Central Highlands are the Chomoga-Yeda flood plains around Debre Marikos, and the Borkena and Dillu swamps in the upper Awash Basin. The numerous alpine lakes of the Bale Mountains and the swamps of Aris and Alemaya are important wetlands in the Eastern highlands.

5.2.1.2 Somali-Masai Wetland System

This biome also exists, in large measure, due to the formation of the Great Rift valley. Its wetlands include the southern group of Great rift Valley Lakes and the northern groups of the Awash Basin together with their associated swamps and marshlands. The water divide of these two wetland complexes is near Maki town. The Awash Basin wetland complex is to the north of

the water divide and includes the wetlands of Bishoftu, the Kesem-Meteka complex and Lake Abe complex. The southern group comprises three separate and closed drainage systems. The first system comprises Lake Langano, Abijatta and Shalla. The second drainage system comprises Lake Awassa and chelekleka, while the third comprises the lakes Abaya, Chamo and Chew Bahir together with their associated flood plains. The rainfall distribution under this biome is bimodal, with peaks between September and November, and March and May (Tilahun et al., 1996)

5.2.1.3 Sudano-Guinean Wetland System

The Sudano-Gunean wetland system is found in the Western lowlands of Ethiopia. the wetlands in this group stretch from Turkana delta in the south-west of Ethiopia, north along the Ethic-Sudanese border, the Baro-Akobo flood plains in Gambela Region, the Dabus and Belese flood plains in the Benshangul-Gumuz Region and the Metama and Tekeze flood plains in Amhara and Tigray Regions. Rainfall is unimodal, from March to September.

5.2.1.4 Sahelian Transitional Wetland System

The Sahelian Transitional zone Biome is found in the extreme north-eastern part of Ethiopia. This area is the hottest and driest part of the country and is where the Dallol depression is located at its lowest point; Dallol is 116 m below sea level. The area comprises Semi-desert steppe, and the evapo-transpiration exceeds mean annual precipitation by over ten times. The biome contains a number of fresh and saline wetlands, including Lakes Afambo, Afdera, Gamari and Asali. The water volume of these lakes is dependant on the rainfall from the highlands during the wet season. In the dry season, most of the water in these wetlands evaporates leaving large salt pans behind. Rainfall is unimodal and unreliable, with a small amount received mainly between November and February.

5.2.2 Classification of Ethiopian Wetlands by Habitat, Physical and Biological Characteristics

Based on habitat type and basic physical and biological characteristics, wetlands may be grouped into 30 categories and nine man-made ones (Dugan, 1990). Using the Directory of African Wetlands as a basis, Ethiopian wetlands are classified into ten major groups, lakes being included (Hughs and Hugs 1992). This classification is based mainly on river and lake drainage systems. The classification is not complete and will need revision. Because they are so numerous, not all Ethiopian wetlands are listed. The classification scheme is, however, able to show the diversity of wetland types in the country. it is not able to cope with the many different forms of wetland e.g. alkaline, fresh or seasonal. It includes those wetlands previously excluded by Hughs and Hughs (1992), but excludes tidal and coastal wetlands because Ethiopia has no access to the sea.

The Lake Tana and associated wetlands

- Lake Tana
- Fogera floodplains

Dembia flood plains

The Ashange and Hayk Lakes

Wetlands of Bale Mountains

- Numerous alpine lakes including Garba Guracha
- Swamps and flood plains

Wetlands of the Western highlands

- Kafa zone-Ghibe and Gojeb
- Illubabor zone

Lakes of Bishoftu

- Creator lakes-hora, Bishoftu, guda and Zukala
- Green, Babugaya, Bishoftu lakes etc.

Lakes and the associated wetlands of the South West Rift valley

- Lake Ziway, Langano, Abijata, Shalla
- Lakes Awassa and Chelekleka
- Lakes Abaya, Chamo, chew -Bahir
- Lake turkana

Lakes and swamps of the Awash river system

- The upper awash valley-Dillu Meda, Abasamuel

The lake Beda sector

- The Gewane lakes/Swamp complex
- The Dubiti, Afambo and Gemari lakes/ Swamp complex
- Lake Abe and Delta

Lakes of the Afar Depression

- Lake Afrera
- Lake Asale
- Dallol Depression

Western river flood plains

- Alwero, Baro,akobo, Gillo
- Chomen, Fincha swamp

- Dabus swamp
- Beles flood plain

Artificial impoundments and micro dams

- Koka, Fincha, Melka-Wakana, Gilgel Gibe and other hydropower dams
- Municipal and other reservoirs like dams, aquifers and wells

5.2.3 Wetlands Can Also Be Classified As Swamps, Marshes, Flood Plains and Peat Lands.

5.2.3.1 Swamps

Swamps are dominated by trees or shrubs and occur in a variety of flooding conditions. Standing water can be present in swamps during all or just a small part of the year. Water chemistry in swamps can vary greatly, depending on the water source. Swamp soils can be rich or poor in nutrients and vary in mineral or organic content. Swamps often occur along river floodplains, in shallow, quiet waters of lakes, and along ponds.

5.2.3.2 Marshes

Marshes are periodically or continually flooded wetlands characterized by non woody emergent plants, plants that are adapted to living in shallow water or in moisture-saturated soils. Different species of emergent plants often occur in zones within a marsh. Marsh zones are determined by the elevation of the soil surface relative to the water level. Water chemistry in marshes depends on the water sources and varies from salt water to mineralized fresh water (from groundwater, streams, and surface runoff) to poorly mineralized fresh water (mostly from precipitation). Marshes often have mineral soils. Coarser soils such as sand are found in areas subject to waves or flowing water; in more protected areas, silts and clays accumulate with dead plant matter to form organic soils. There are several marshy areas in the south and south west part of the country and use for dray period grazing and reed harvesting.

5.2.3.3 Peat Land

Water chemistry often determines which plant species grow in a peat land. Peat lands with groundwater sources (known as fens) often have more mineralized water and are dominated by sedges, grass like flowering plants. Peat lands that receive water only from precipitation (called bogs) have poorly mineralized water and are usually quite acidic, especially if sphagnum mosses are abundant. Though there are peat lands in Ethiopia, its proportion in relation to swamps and marsh lands is not known.

5.2.3.4 Flood Plains

Floods play a central role in creating and shaping floodplains. During a flood, the flow of a river is both deeper and faster, allowing it to carry more sediment. As the flood recedes, the depth and speed of the river diminishes and the river deposits some of its sediment load in flood plain. As the water that has overflowed the banks slows, it deposits some of its sediments. This leads to a build-up of sediment, which produces flood plain running parallel to the channel. Flood plains area common along large rivers such as Baro-Akobo, at the lower reach of Omo-Ghibe,

Awash and Nile. Since floodplains are constructed of the material being carried by the river, they are composed of relatively fine sediment. Most floodplains are composed of sand, silt, and clay, but floodplains of gravel occur where the water flows especially fast.

5.2.4 Roles and Functions of Wetlands in Ethiopia

5.2.4.1 Habitat for Plants and Animals

Because they have both land and aquatic characteristics, wetlands are some of the most diverse ecosystems on earth. They provide habitat for a wide variety of plants, invertebrates, fish, and larger animals, including many rare, threatened, or endangered species. The plants and animals found in wetlands include both those that are able to live on dry land or in the water and those that can live only in a wet environment.

A large number of fish species require wetland habitat for spawning, feeding, or protection from predation. Birds are attracted to wetlands by abundant food resources and sites for nesting, resting, and feeding. Many breeding and migratory birds, especially waterfowl, are associated with wetlands.

Table 5.1: Summery of bird species counted in Ethiopia during AFWC 2000

No.	Site Name	Survey date	Number of species	Number of water-fowl spp	Total number of water-fowl
1	Lake Abijata	22/01/2000	51	44	31,119
2	Akaki wetland	15/01/2000	62	43	11,364
3	Lake Ardibu	22/12/1999	73	39	962
4	Arket swamp	30/01/2000	54	36	3383
5	Lake Ashange	25/12/99	69	38	6,501
6	Lake Awassa	26/01/2000	159	84	14,462
7	Babo Gaya swamp	16/01/2000	60	42	3929
8	Berga flood plain	14/01/2000	57	21	672
9	Borkena Mersh	20/01/2000	117	49	1915
10	Boyo Wetland	29/01/2000	78	43	1802
11	Cheleklek swamp	16/01/2000	74	45	2,786
12	Lake Chitu	28/01/2000	47	13	55,826
13	Green Lake	17/01/2000	65	20	1,151
14	Gudo flood plain	13/01/2000	41	25	913
15	Lake Hayk	23/12/99	92	38	1,682
16	Infranz Wetland	01/01/2000	84	32	490
17	Koka Dam	18/01/2000	111	53	3596
18	Kurtu Bahir Swamp	03/01/2000	74	29	686
19	Lake Langano	23/01/2000	69	39	1,101
20	Shesher-Wollala Swamp	29/12/1999	98	62	16,761
21	Tikur Marsh	02/01/2000	95	38	537
22	Tikur Woha	27/01/2000	95	30	308
23	Yiganda Marsh	31/12/99	108	35	925
24	Wagetera Swamp	28/12/99	67	34	13,000
25	Lake Ziway	20/01/2000	125	58	1,855

Source: IUCN, 2003, Proceedings of a seminar on the resources and status of Ethiopia's wetlands

In Ethiopia there are a total of 73 hotspots have been identified as important bird areas (IBAs). 30 of these sites (41 % of total) comprise wetlands, while the rest are representative of other types of ecosystems, indicating the importance of wetlands as bird habitats.

Nationally, Ethiopian IBA sites have been grouped into three conservation categories: critical (19), urgent (23) and high (31). Table below depicts their relation ship between IBAs, wetlands and their conservation status.

Table 5.2: Rrelation ship between IBAs, wetlands and their conservation status.

IBA site categories	Total	%	Wetland IBAs	%
Critical	19	26.03	4	13.33
Urgent	23	31.51	12	40.0
High	31	42.46	14	46.67
Total	73	100	30	100

Source: IUCN, 2003, Proceedings of a seminar on the resources and status of Ethiopia's wetlands

5.2.4.2 Control Floods

Inland wetlands may help to control floods by storing water and slowly releasing it to downstream areas after the flood peak. Wetlands can reduce wave action and slow down the flow of water, lessening erosion and causing sediments to settle out of the water. This improves water quality, as does the removal of nutrients and contaminants from the water by growing wetland plants and by chemical processes in wetland sediments. The good example of this is wetlands on Baro river basin. However, due to the reduction of wetland area in Baro river basin, the extent of wet season flooding is increasing from time to time.

5.2.4.3 Recharging Of Ground Water and Springs

Wetlands situated in a pervious strata or geological formation may serve as sites where surface water can seep into the ground and replenish the groundwater and spring flow. A lot of springs also emerged from wetlands and provide water for people and animals living around.

5.2.4.4 Tourist Attraction and Recreation

Wetlands provide many opportunities for recreational activities, such as bird-watching, hunting and fishing and they provide educational opportunities for nature studies and scientific research. Wetlands are also valuable for the food and timber harvested from them.

Some of the known wetland areas with tourism potential include Rift valley lake areas such as Lake Abijata, Shalla, Langano, Ziway, Hora, Bishoftu, Awasa, Abaya and Chamo. There is also recently increasing Lake known as Lake Beseka at the base of mount Fantale. Other lakes found on the northern part of the country including Lake Tana, Hayk, and Ashange are also known for harboring different species of water fowls, fish and crocodiles. There is also unique Crater Lake known as Lake Wonchi at a higher altitude. These wetland areas distributed in different climatic and topographic zones make the country a home for different species of aquatic and wetland species. This variation would be exploited for the development of tourism and conservation of species in their natural habitat.

5.2.4.5 Food Security and Livelihood

Wetlands are very valuable areas for rural communities mostly in the South west and North West Ethiopia. They contribute directly to food security through the production of green and mature maize and vegetables. The main harvest from these areas, in the early rainy season, is ready just when the supply of food from the upland fields is running out for many families. Indeed wetland cultivation at this time of a year can be seen as a source of food security, especially for those people whose upland harvest is poor.

In addition, many of the rural people obtain the other essential requirements for life, drinking water, from wetland edges springs. The function of these sources of relatively safe water is dependant on the water table level which is maintained by the wetland.

Wetlands also contribute indirectly to food security by providing products which people can collect and sell to provide them with cash for purchasing food. Some of the poorer people make a living from collecting craft materials which they either sell or use for making craft items for sale. Medicinal plants are also found in wetlands and these items contribute to the well-being of households through direct use or through sales. Wetlands have been used increasingly for the grazing of cattle.

Wetlands are also beginning to be used for brick making as urban housing standards rise. This is mainly occurring in the areas accessible to the towns of Jima and Agaro, in Jima zone, where the urban growth is most rapid and coffee earnings contribute to higher incomes.

Table.5.3: Wetland uses and their relative importance

Use	Estimate of Households benefiting
Social/ceremonial use of sedges	100 %(including urban dwellers)
Thatching sedges	85 % (most rural households)
Temporary crop guarding huts of sedges	30 %
Dry season grazing	Most cattle owners
Water for stock	Most cattle owners
Cultivation	25 %
Domestic water from springs	50 %-100 % (depending on the locality)
Craft materials(palm products and sedges)	5 %
Medicinal plants	100 % (most indirectly by purchase from collators/traditional doctors)

Source: Ethiopian wetlands research program, field records, 1997-2000

5.2.5 Policies and Wetlands

5.2.5.1 International Convention on Wetlands

By 1991 over 60 countries had joined the Convention on Wetlands of International Importance Especially as Waterfowl Habitat, adopted in Ramsar, Iran, in 1971 (enforced since 1975) and known as the Ramsar Convention. Member countries are required to designate at least one wetland as a conservation project to add to the List of Wetlands of International Importance. The Ramsar List includes more than 30 million hectares (74 million acres) of wetlands in more than 500 locations—still only 3 percent of the total wetland area of the world. Twenty of these sites are considered to be seriously at risk, and many have no management program.

Conflicts over wetland policies in the world remain as an issue, since the general public benefits the most and individuals the least from restrictions on developing wetlands. Much of the controversy centers on the legal definition of a wetland. Many wetland advocates believe that a greater area of a wetland should be protected than the area suggested by some landowners or developers

5.2.5.2 Policies and Wetlands in Ethiopia

Concerning wetland policy in Ethiopia, three levels are particularly worthy of attention, the national/ regional, the local (community level), and the NGO level. Once policies and their influences upon wetland are identified, then appropriate actions can be designated which where necessary can try to influence these policies and make them more appropriate for the sustainable use of wetlands. The long-term aim should be not to correct policies after they have been promulgated, but to ensure that all polices should go through some environmental assessment process before they are finalized.

National wetland -specific policies

There are few policies which specifically address wetlands in Ethiopia. The Ramsar convention has not been signed by Ethiopia and so there is no related legislation. The conservation strategy of Ethiopia (CSE) and the water resources management policy are the only formal government policy statements to make mention of wetland. However, they address them indirectly focusing them as regulators and of water quality in the CSE, and for their biodiversity and assimilative capacity against pollution in the Water resource management policy. Hence it is clear that at the national level wetland are not on the policy agenda in their own right. Indeed it might be said that there is a policy vacuum when it come to the consideration of wetlands in their own right.

National non-wetland policies with direct impacts on wetlands

A number of non-wetland polices have quite immediate or direct impacts upon wetlands even though they were not designed with reference to these areas at all.

Food security strategy is one of the strategies, which impose impacts on wetland resources of the country. The drive towards food security seeks to ensure that supposedly under used natural resources are developed for agriculture production. This strategy has been subject to interpretation at the regional and zonal levels. In some parts of the country, diversion irrigation is being encouraged. In other cases wetland drainage has been encouraged. The later is especially attractive as it can lead to crop harvests during the food-shortage months before the main harvest. However, intensive cultivation, especially with limited knowledge about wetland management, can lead to serious degradation of wetland.

Other policy, which has impact on wetland is resettlement. The past policy of relocating people from famine affected areas to the better watered south-west of the country led to sudden local increases in the demand for land. Where resettlement was of the integrated type local community faced a dilemma as to which land they allocated to the settlers. In many cases it appears that wetlands were seen as the least desirable type of land by the local communities and were given to the settlers.

The need to eradicate poverty in Ethiopia has seen an emphasis upon the development of the country's natural resources. This has led to agricultural expansion and the clearance of forests.

The resulting de-vegetation of the landscape has had serious impacts upon the hydrological cycle with increased variations in stream flow, and more sever down cutting in wetlands by stream at times of peak flow. One result is that wetlands start to dry up. This allows cattle to graze them which lead to soil compaction, loss of water storage capacity and destruction of wetland vegetation.

5.2.6 Constraints of Wetland Ecosystem

A wetland ecosystem of the country is being severely disrupted by de-vegetation and draining for agriculture, heavy silt loads, pollution and over extraction of resources. Some of the wetlands particularly those around towns are receiving municipal and industrial wastes. This is due to the fact that little consideration given by the concerned institutions and severe poverty of local community making the exploitation of the natural resources to exceed the capacity of the available resources. Also lack of confidence on the ownership of land tenure contributes for the further degradation of natural resources including wetlands. The consequences are obliviously the degradation of biophysical features of the wetlands, which can be a major threat for the whole wetland ecosystem.

Resettlement and villagaztion in the rural areas have the effect of increasing demand upon the natural resources in some localities. Needs for thatching houses put a heavy demand upon the wetlands near to the new villages and affected the quality of the reed beds. In addition, the need for more accessible farm and grazing land lead to the drainage of wetland in the vicinity of these new settlements.

Intensive cultivation by draining the wetlands, especially with limited knowledge about wetland management is leading to serious degradation of wetlands. Also expansion of coffee production, a national goal which has been supported by many donors in the west and south, has had a number of impacts upon wetlands. Most directly the expansion of coffee land on the interfluves has displaced cereal crop cultivation from these areas into wetlands.

5.2.7 Indicators for Evaluation and Monitoring of Wetlands Sustainability

5.2.7.1 Definition of Wetland Ecosystem Indicators

Wetland ecosystem indicators are indicators, which give us information about the change and trend of wetland ecosystem. They are used to quantify, communicate and create order within complex data. They provide information in such a way that policy makers and public can understand and relate to wetland ecosystem. Indicators help us to monitor progress and trends in the use and management of wetland ecosystem over time and space. Similarly, these indicators can help us to compare results in different areas or countries and examine potential links between changing conditions, human behavior and policy choices concerning the wetland ecosystem. They also help to compare actual situation with the desired or planed state. Because good indicators are easy to understand, they offer a tool for raising awareness about wetland ecosystem that cuts across every social and political group.

5.2.7.2 Criteria for the Selection of Good Indicators

- Indicators can be either descriptive or normative
- They should indicate quantitative or qualitative information

- Indicator should enlighten its user and provide a sense of the issue being examined.
- Indicator can be a simple data point or variable, or can be a simplified value derived using a complex mathematical algorithm
- Indicators should be comparable in time and space
- They should be understandable and capable to measure changes and trends clearly
- The numerical value of an indicator should represent the degree of what should be measured directly
- Ambiguity and arbitrariness should be excluded from measuring with indicator
- The cost of the evaluation by indicator should be affordably low, and
- Indicator should be easily comprehensible to use

5.2.7.3 Proposed Indicators for the Wetland Ecosystem

Based on the above criteria, the following indicators are proposed to monitor the sustainability of wetland ecosystems in Ethiopia:

- Number of wetlands with conservation and management plan
- Number of wetlands registered as Ramsar site
- Total area of wetlands in ha
- Hectares of wetland converted into agricultural field per year or vice versa
- Hectares of wetland converted to irrigated farm per year
- Ratio of protected wetland area over total area of the wetland
- Number of water-fowl spp in a selected wetland habitats

Indicators for the monitoring of Wetland sustainability

Indicators	**Available data as of 2004**
Number of wetlands with conservation and management plan	0
Number of wetlands registered as Ramsar site	0
Total area of wetlands in km^2	13,699
Hectares of wetland converted into agricultural field per year or vice versa	no data
Hectares of wetland converted to irrigated farm per year	no data
Ratio of protected wetland area over total area of the wetland	0
Number of water-fowl spp in a selected wetland habitats -Lake Langano* -Lake Awassa -Lake Abijata -Lake Ziway -Lake Hayik -Lake Ashenge	 39 84 44 58 38 38

**number of water-fowl species was counted in year 2000.*

**source: IUCN, 2003, proceedings of a seminar on the resources and status of Ethiopian Wetlands*

Currently, there is no wetland area, which has got conservation and management plan in Ethiopia. Concerning Ramsar convention, Ethiopia has not signed the convention. Therefore, currently we have no wetlands registered as Ramsar site.

At present there is no protected wetland area in the country. Therefore, ratio of protected wetland area over the total area of the wetland is zero

Hence, the strategy to solve the wetland ecosystem degradation problem should include:

- An appropriate institution should be created with mandate to implement policies, provide alternatives to actions that cause wetland degradation and to formulate modalities for a national wetland management program. This would provide an understanding of wetland values and problems, as well as filling gaps to support the protection and wise use of wetland ecosystems in the country
- Delineation and registration of wetland areas
- Preparing conservation and management plan for selected and very important wetland areas
- To gain technical support and development assistance, the country must ratify international wetland agreement, Ramsar convention and register Ramsar sites with conservation and management plan
- Conduct inventory study of wetland areas of the country using Land Sat imagery.
- Enhance stakeholders awareness through programs in the media, workshops, short courses etc
- Empower local communities to conserve and protect their wetlands

5.3 Aquatic Ecosystem

5.3.1 Description of Existing Aquatic System of the Country

Ethiopia, with its different geological formations and climatic conditions, is endowed with considerable water resources and wetland ecosystems, including twelve river basins, about 14 major lakes, and some man made reservoirs. About 123 billion cubic meters of water runs off annually from the above sources. Most of them are trans-boundary Rivers.

5.3.2 Major River Basins

Major river basins of Ethiopia include: Blue Nile, Wabishebel, Genele-Dawa, Awash, Tekeze, Baro-Akobo, Omo-Ghibe and Rift valley lake basin. Most of these Rivers are Trans boundary Rivers.

Table5.4: Major river basins, catchments areas and annual discharges

No.	Basins	Catchment area		Annual Discharge	
		(km2)	%	(billion m3)	%
1	Abay	199,812	17.56	54.4	43.05
2	Awash	112,700	9.9	4.9	3.76
3	Baro-Akobo	74,102	6.51	23.23	19.31
4	Genele-Dawa	171,050	15.03	6.1	4.81
5	Tekeze	90,000	7.9	8.2	6.24
6	Wabi-shebele	200,214	17.59	3.16	2.59
7	Omo-Ghibe	78,200	6.87	16.6	14.7
8	Mereb	5,900	0.52	0.72	0.21
9	Rift valley Lakes	52,740	4.63	5.64	4.62
10	Danakil	74,0002	6.5	0.86	0.7
11	Ogaden	77,100	6.77	0.0	0.0
12	Aisha	2,200	0.19	0.0	0.0
	Total	1,138,020	100	123.81	100

5.3.3 Lakes

In addition to Rivers, the country is endowed with several lakes, among which Lake Langano, Abijata, Shala, Ziway, Hora, Beseka, Alamaya, Wonchi, Awasa, Chamo, Abaya, Tana, Hyke and Ashange are the major once. In addition to these lakes, there are also a number of man made reservoirs mainly constructed for hydropower and water supply purposes.

These Lakes situating in different topographic and climatic zones hold diversified species of animals and plants.

Except very few water bodies like Lake Tana, Abijata and Awasa there is no detailed study on the status of ecosystem. Especially phytoplankton, zooplankton, amphibians, reptiles and grasses of different species need through study for identification, classification and their use.

Major aquatic mammals known to dwell in major rivers and Lakes are Hippopotamus and Nile crocodile. There are also different fish species in these rivers and Lakes. Number of fish species found in the major rivers and lakes of Ethiopia are listed below:

Table 5.5: Number of Fish species as listed in fish Base, 1997

Origin	No of species
Primary fresh water	62
Secondary freshwater	0
Introduced fresh water	3
Total	65(incomplete)

Use and status	Reported	Potential
Species used in fisheries	0	19
Species used in aquaculture	0	9
Species exported live	0	4
Species used as sport fish	0	7
Endemic species	2	17
Threatened species	3	-
Protected species	0	0

Source: Abay River basin integrated development master plan project, phase 2, section II volume II, 1998.

5.3.4 Policies Pertinent to Aquatic Ecosystem in Ethiopia

The relevant policy pertinent to aquatic ecosystem in the country is water resource management policy. This policy under the heading of aquatic resource policy states among others that:

- Establish and adopt water quality standards and proper assessment procedures that enhance preservation and enrichment of aquatic resources.
- Incorporate aquatic resources development in large-scale water resource undertakings.

Under the water allocation and apportionment, the policy states that:

Recognize that the basic minimum requirement, as the reserve (basic human and livestock needs, as well as environment reserve) has the highest priority in any water allocation plan.

Concerning environment the policy states among others:

- Incorporate environment conservation and protection requirements as integral parts of water resources management
- Encourage that environment impact assessment and protection requirements serve as part of the major criteria in all water resources projects

The other pertinent policy concerning aquatic environment is the environmental policy of Ethiopia. This policy under water resource policy stated that interface between water and land such as shores of lakes; rivers and swamps should be maintained and conserved.

5.3.5 Constraints of Aquatic Environment

Due to the conducive development and investment policies of the country, various type of industries are being planted, mining practices are picking up, different scale of irrigation schemes are flourishing in various parts of the country. Moreover, a lot more projects of different nature will continue to flourish in the near future.

It is evident that all these development activities will greatly contribute to the development of the economy of the country and raise the standard of living in the country. However, it should also be conceived that apart from all the positive impacts, these development endeavors will inflict negative impacts of varying degrees on the Ethiopian environment in general and on the water resources and its ecosystem in particular. Far-reaching economic, social and demographic changes through out the country will have major impacts on the overall water quality and its ecosystem.

So far, in Ethiopia there is no systematic water quality assessment program. The few available reports and studies made have shown that there are increasing indications of water pollution problems in some parts of the country. With the present increasing rates in population, growing industrialization, urbanization, mining activities, intensified agricultural as well as other development activities, there will be an increase in the amounts of liquid, solid and atmospheric pollutants. It is therefore, imperative that the quality of unprotected ground water surface water will continue to decline. Increased use of pesticides, fertilizers and other organic chemicals will definitely pollute groundwater and receiving surface water bodies.

Industrial pollution: industrial pollution is an area that has drawn little attention in Ethiopia. The majority of industries in Ethiopia are located along the banks of rivers and streams from where they draw water for their processes. Most of the high water consuming industries in Ethiopia are discharging their wastewaters directly in the streams and water courses without any kind of treatment whatsoever. Added to this, so far there is no strict restriction on industrial plants discharging their wastewater into the rivers and water courses. Most industries directly discharge their wastes into the near by water course because they have no waste water treatment facilities. On the other hand however, the few industries in the city of Addis Ababa which are equipped with treatment facilities divert their raw waste water into the storm water drainage system or the water course. The reason could be either for technical reasons related to the waste water treatment plant operation or for practical reasons since there are no regulations and effective control regarding industrial and domestic discharges by concerned bodies

Agricultural pollution: polluting substances introduced as a result of agricultural activities include: chemical fertilizers, insecticides, herbicides and organic matters. These pollutants enter into the water bodies mainly through surface run-off and irrigation return flows

In Ethiopian context, pesticides and herbicides are common agricultural inputs on large scale farms while fertilizers serve as major inputs on both large scale farms and in the peasant agriculture plots. Pesticides mostly used include chlorinated hydrocarbons, organo-phosphorus compounds and carbamate compounds. Fertilizers in use are basically of nitrogen and phosphorus origin.

Further more, control of diseases vectors are carried out using pesticides like DDT and Lindane whose residues are persistent for longer periods, which are toxic and their use has been banned in many countries. Apart from the significant benefits of the large scale irrigation projects for instance in the Awash valley, there are some adverse effects inflicted on the environment such as salinity problem, problems due to agricultural inputs (fertilizers and pesticides), health related problems (malaria, shistosomiasis) and municipal and domestic pollutions.

Water shed degradation and associated silitation of Lakes, reservoirs and rivers

Due to unwise utilization of land, deforestation and overgrazing of water shed, soil erosion is increasing from time to time and cause silitation of lakes, reservoirs and rivers. Lake Alemeya, Awasa and Koka reservoirs are live examples of silitation problem that originated from the water shed degradation.

5.3.6 Indicators for Evaluation and Monitoring of Aquatic Ecosystem

5.3.6.1 Definition of Aquatic Ecosystem Indicators

Aquatic ecosystem indicators are indicators, which give us information about the change and trend of aquatic ecosystem. They are used to quantify, communicate and create order within complex data. They provide information in such a way that policy makers and public can understand and relate to aquatic ecosystem. Indicators help us to monitor progress and trends in the use and management of aquatic ecosystem over time and space. Similarly, these indicators can help us to compare results in different areas or countries and examine potential links between changing conditions, human behavior and policy choices concerning the aquatic ecosystem. They are also help to compare actual situation with the desired or planed state. Because good indicators are easy to understand, they offer a tool for raising awareness about aquatic ecosystem that cuts across every social and political group.

5.3.6.2 Criteria for the Selection of Good Indicators

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- Indicator should be easily comprehensible to use

5.3.6.3 Proposed Indicators for the Aquatic Ecosystem

The following indicators are proposed to monitor the sustainability of aquatic ecosystems in Ethiopia:

- Dissolved oxygen level of rivers, Lakes, reservoirs and ponds measured form a known sampling sites in mg/l
- Nitrate concentration of Lakes, reservoirs and ponds measured form a known sampling sites in mg/l
- Phosphate concentration of rivers, Lakes, reservoirs and ponds measured form a known sampling sites in mg/l
- Total dissolved solids in mg/l at known points of the river Lakes, reservoirs and ponds measured form a known sampling sites in mg/l
- Turbidity in NTU at known points of the river
- Number of Fish species at a known location

Table 5.6: Some Water quality Baseline data or indicators measured from 2000 onwards

	Do mg/l	Turbidity NTU	NO3 mg/l	PO4 mg/l	TDS mg/l
Lake Alemeya	Nd	13	4	0.12	1025
Lake Ziway	Nd				
Lake Beseka	Nd		11	5	4989
Lake Wonchi	5.5	nd	nd	2.8	420
Lake Abaya	Nd		nd	nd	530
Tekeze River at yechila	7.7	26	0.97	0.54	142
Omo River below the confluence with Gilgel Gibe	Nd	210	6.6	0.21	108
Dedesa River at Dedesa bridge	Nd	nd	2.0	0.18	51
Mojo river at Mojo Bridge	Nd	36	2.64	0.16	457
Awash River at Awash park	Nd	68	1.32	0.41	315
Wabishebele river at Dire Shekhusen	Nd	277	6.16	0.26	122

Source: MoWR, water quality data base

nd: no data available

As there is no national water quality monitoring system in the country, it would be difficult to characterize the pollution status of the aquatic system of the country. Therefore it is recommendable to establish at least a water quality monitoring system for the major aquatic system using selected water quality indicators. Also establishing biological indicators like use of aquatic invertebrates for pollution monitoring would be important.

5.4 Terrestrial Ecosystem

5.4.1 Terrestrial Flora

Ethiopia is acclaimed for being an important regional center of biological diversity. The Ethiopian high lands are one of the six cradles of primary plant domestication in the world. Of the sixteen major crops domesticated in the country, three, namely coffee (Coffee arabica), Okra (Abelmoschus esculentus) and castor bean (Ricinus communis) were uniquely domesticated in Ethiopia. There are at least 197 species of crops with important gene pools in Ethiopia. Crop types include grains, pulses, oil seeds, vegetables, tubers, fruits, spices, stimulants, fibers, dyes and medicinal plants. In addition at least 25 plant families have wild species growing in Ethiopia, which are close relatives of crops. Such gene pools are of immense potential value in developing new crops or new varieties of existing crops.

Ethiopia is also an important center of genetic diversity of forage plants. About 46 legumes, most of which are found in the highlands, are endemic. Some 28 of the 40 African species of Trifolium occur in Ethiopia, of which 9 are endemic. In terms of Agricultural resources, Ethiopia's biodiversity is one of the most important on the African main lands.

The vegetation of Ethiopia is very heterogeneous and has a rich endemic element. There are no accurate estimates on the size and endemism of Ethiopian flora. A report issued by the world conservation and monitoring center (WCMC) in 1991 estimated the country's flora at 5,765 species, of which 10-20 percent is endemic. However, Tewolde B.G.Egziabher (1991) estimated 6,500-7000 species with 12 per cent endemics.

The biodiversity institute (1997) and the wood utilization and research center(1995) have reported the Ethiopia has 14 species of potentially useful multipurpose trees and shrubs, 36 merchantable hardwoods, 4 merchantable conifers, 25 potentially usable hardwoods and 56 potentially desirable hardwoods.

5.4.2 Forest Genetic Resource Conservation

As it is noticed above, in Ethiopia vegetation types in general and the diversity of trees/shrub species in particular, have not been adequately studied. The classification of forest resources and vegetation types provided by different authors and institutes are not consistent. Consequently, the diverse forest ecosystems and genetic variation within forest tree species is not well known.

It is often stated that 40 percent of the Ethiopian highlands were covered with coniferous and or broad leaved forests not more than a century ago. Now days the coverage of forest is estimated to be less than 3 %. Most of the remaining forest blocks are found in Jima, Illubabor, Wellega, Bale, Arsi, West Shewa zone s of Oromia Regional State, and in the north east, south and south west of southern Nations, Nationalities and Peoples' Regional State. However these forests are diminishing fast due to human encroachment.

In Ethiopia, forest genetic resources can be conserved in siitu and/or exsitu at three levels, ecosystem, species and genes.

The conservation of wide diversity of species and variation in forests is dependent on maintaining essential functional components of the ecosystem. Ecosystems in need of conservation can be identified by means of a botanical classification system. Representative ecosystems include the Forest Priority Areas (FPA), hillside closures, forest patches around places of worship, watersheds, farm forests and other woody vegetation types within the lowland formations.

About 58 FPAs are designated for production, protection, and biodiversity conservation includes the most important forest ecosystems in Ethiopia. These cover an estimated 3.7 million ha of varying size, density, compositions and quality including man-made plantations, grazing areas and settlements. The high forests total 2.3 million ha. None of the FPAs are Gazetted. The management plans prepared for three FPAs namely Munessa-Shashemane, Tiro-Boter Becho and Menagesha-Suba. There are also some minor areas as nature reserves to preserve the tree species and associated flora and fauna.

Some of the FPAs may be dedicated to conserve intra-species variation in a network of conservation areas containing selected target species or sub specific populations. The strict management of a selected FPA to favor one or a few species may be useful for conserving the principal species' genetic resources, albeit at the expense of the broader genetic diversity of the ecosystem. While the Gera forest is example for Arabica coffee, the forest in Jibat and Menagesha -Suba could be considered for the conservation of Hagenea Abyssinia and Junipers procera, respectively.

The biodiversity institute (1997) stated that under the prevailing conditions for in situ and ex situ conservation may be given to selected indigenous multi-purpose trees, commercial timber species, exotic species, tannin bearing plants, traditional medicinal plants and those which can be used for the production of essential oils, natural gums and resins.

Table 5.7: List of some economically important trees

Tannin bearing plants	Natural gum and resin bearing plants	Essential oil bearing plants
Osyris abyssinca Acacia mearnsii Acacia albida Pinus radiata Acacia senegal Acacia decurrents Eucalyptus occidentalis	Acacia senegal Boswellia papyrifera Boswellia rivae Commiphora myrrha Boswellia ogadensis	Eucalyptus citrodora Cymbopogon ciratus Rosa damacena Eucalyptus globulus

Source: Journal of the Ethiopian wild life and Natural History Society, 1997.

Some endemic plants of Ethiopia

So far over 200 endemic species of plants have been recorded in Ethiopia. Here, some more conspicuous and commonly encountered endemic species are listed.

Table5.8 Some endemic tree and shrub species of Ethiopia

Acacia oliveri	Erythrina burana
A. venosa	Euphorbia bittataensis
A. pseudonigrescens	E. makallensis
A. prasinata	Kniphofia foliosa
A. negrii	kohautia platyphylla
A. buvazzanoi	lobelia rhynchopetalum
A. walwwlensis	Millettia ferruginea
Acanthus sennii	Pentas caffensis
Alchemilla haumannii	P.conciunna
Bidens ghedooensis	Polyscias farinosa
Boswellia pirottae	Polysphaeria aethiopica
Crsium engleriannum	Rubus erlangeri
Crotalaria fallax	Solanecio gigas
C.boudettii	Taverniera anyssinica
C. heterotricha	Triflium somalense
cussonia ostinii	T. chilaloense
Echinops ellenbeckii	T.spananthum
Echinops longisetus	Urtica simensis
Echinops kebericho	Vepris dainellii
Erythrina brucei	

Sources: Mesfin Tadesse, 1991, some endemic plants of Ethiopia

Ensermu Kelbesa, Sebsebe Demissew, Zerihun Woldu and Sue edwards, 1992, some threatened endemic plants of Ethiopia

5.4.3 Policies Pertinent to Forestry

Ethiopia's environmental policy (issued in April 1997) on genetic, species and ecosystems conservation and management underscores the need to preserve, develop, and manage and sustainable use the diverse wild and domesticated flora and faunal gene pool and species. The policy also provides for the conservation of natural and human-managed ecosystems in support of national, social and economic development and the integrity of the biosphere.

More specifically the policy seeks to:

- promote the crucial role of local communities inside and outside protected areas in the conservation of biological diversity;
- ensure that the conservation of biodiversity outside the protected area system be integrated with strategic land use plans, local level plans and sustainable agricultural and pastoral production strategies;
- include in protected areas as wide a range of ecosystems and habitats as possible and where appropriate to link them by corridors of suitable habitats along which species can migrate;
- ensure that pricing policies and instruments support conservation of biodiversity;
- ensure that aforestation uses local species as these are in tune with the environment and thus ensure its well-being;

- assist the natural process of afforestation of uncultivable areas by controlling felling and grazing and by planting judiciously selected local species, as well as by other affordable interventions;
- Pursue agricultural practice and other policies and programs that will reduce pressure on fragile woodland resources ecosystems; and
- Ensure that park, forest and wildlife conservation and management programs, which conserve biodiversity on behalf of the country, allow for a major part of any economic benefits deriving there from to be channelled to local communities affected by such programs.

The strategic importance of Ethiopia's biodiversity endowment to sustained economic development, food security and maintenance of the life-support systems of the environment are also stressed in the policy on biodiversity conservation and development. In addition, the Ethiopian forestry action program (EFAP) has outlined the objectives, strategies, actions and investments for ecosystem conservation, which has significant implications for biodiversity conservation

Nevertheless to the indicated policy environment, there are many factors that currently limit effective conservation of biodiversity.

5.4.4 Terrestrial Fauna

5.4.4.1 Avifauna

Ethiopia provides habitat for about 816 species of birds, of which 16 are endemic. Another 13 species formerly endemic to Ethiopia are now shared with Eritrea. These figures point to a substantial degree that the endemism within Ethiopia ranks the country as one of the important centers of avifauna in Africa.

More over, there are 31 globally threatened species of which five are endangered, 12 are vulnerable, and 14 near threatened and 13 restricted species. Eleven of Ethiopia's endemic birds fall into any of the above mentioned three categories. Further more, 48 Highland, 17 Sudan-Guinea, 100 Somali Masai biome species and 8 Shale species have been recorded for the country. It also provides sites important for over 200 wintering or passage migrants.

Table 5.9: Endemic bird species of Ethiopia

No	Common name	Scientific name
1	Harwood's Francolin	Francolinus hardwoodi
2	Spot-breasted Plover	Vanelleus melanocephalus
3	Yellow-fronted Parrot	Poicephalus flavirfrons
4	Prince Ruspoli's Turaco	Tauraco ruspolii
5	Nechisar Nightjar	
6	Abyssinian Woodpecker	
7	Abyssinian Longclaw	Macronyx flavicollis
8	Abyssinian catbird	Parophasma galinieri
9	Black-headed siskin	Serinus nigriceps
10	Degodi Lark	
11	Sidamo Long-clawed lark	
12	White-tailed Swallow	Hirundo megaensis
13	Yellow-throated serin	
14	Ankober Serine	
15	Salvadori's Seedeater	
16	Abyssinian Bush Crow	

Source: Ethiopian wildlife and National History Society, Important Bird Areas in Ethiopia

Table 5.10: Globally threatened species found in Ethiopia

Near threatened bird species	Vulnerable bird species	Endangered bird species
Shoebill	Ferruginous Duck	White-winged flufftail
Lesser Flamingo	Great Spotted Eagle	Prince ruspoli's Turaco
Pallid Harrier	Lesser Keestrel	Sidamo Long-clowed Lark
Rouget's Rail	Taita Falcon	Yellow-throated Serin
Little Brown Bustard	Harwood,s Francolin	Ankober Serin
Great Snipe	Wattled Crane	
Black-winged pratincole	Corn Crane	
White-winged Collared Dove	Degodi Lark	
Friedmann's Lark	White-tailed Swallow	
Abyssinian Longclaw	Salvadori's Seedeater	
Sombre Rock Chat	Abyssinian Bush crow	
Basra Reed Warbler		
Somali Short-billed Crombec		
Cinereous Bunting		

Source: Ethiopian wildlife and National History Society, Important Bird Areas in Ethiopia

5.4.4.2 Wild Mammals

Like the bird species, Ethiopia is also rich in mammals. There are about 260 species of mammals. At species level 21 mammal species of Ethiopia are categorized as threatened by IUCN among which the Rhinoceros, Dibatag, Ethiopian wolf, Walia ibex, Wild Ass, Swayne's Hartbeest, Tora Hartbeest and the Grevy;s Zebra are endangered.

Table 5.11: Major endemic mammals of Ethiopia.

No	Common name	Scientific name
1	Walia Ibex	Capra walie
2	Swayne's Hartebeest	Alcelapus buselaphus swaynei
3	Mountain Nyala	Tragelaphus buxtoni
4	Minelik's Bushbuck	Tragelaphus meneliki
5	Somali wild Ass	Equus asinus somalicus
6	Semien Fox	Canis simensis
7	Gelada Baboon	Theropithecus gelada

Source: Endemic Mammals of Ethiopia, Ethiopian Tourism commission, 1995

5.4.5 Distribution of National Parks and Conservation Areas of Wild Life in Different Regions of Ethiopia

5.4.5.1 Addis Ababa Region

This region includes the city of Addis Ababa and the surrounding countryside. Lying with in the altitudinal range of 2300-3000 m the region is classified under the Dega agro climatic zone. Except for a number of public recreation parks, the region has only one national park known as Entoto national park. It is run by the Ethiopian Heritage Trust.

Addis Ababa, due to its remnant and quite diverse flora, is home to over 200 bird species including a number of endemic and threatened species. The region holds two important bird areas (IBAs). Entoto National Park and Gefarsa reservoir. While both are vitally important for highland biome species, Gefersa reservoir supports a number of migratory and resident water birds in addition to a notable number of the endemic Blue-winged goose. Among the endemic and highland biome species found in the region, Abyssinian Longclaw, Abyssinian woodpecker, Rouget's Rail, Thick-billed Raven, White-billed Starling, Wattled Ibis, White-collared pigeon, Black-winged Lovebird, Abyssinian Catbird, White-winged Clif chat and White-winged Black Tit are most notable.

5.4.5.2 Afar Region

Afar region is found in the eastern lowlands of Ethiopia and shares its border with Eritrea and Djibouti. It is both the driest and the hottest part of the country and has given its name to one of the most fascinating geological phenomena on the face of the earth. It is the place where, man's oldest ancestors. Australopithecus afarensis, represented by Lucy, lived more than three million years ago.

Most of the Afar Region is below 1000 m and in the Dalol depression the surface goes to 116 m below sea level. The major habitat types identified in the Region are riverine forest, wetlands, dry river beds, Rocky hills and mountains, acacia woodland and grass land, semi-desert steppes and human settlements.

There are four IBAs identified for the Region, namely, Lacke Abe wetland system, Aliyu Amba-Dulecha, Awash River Valley, and Yangudi-Rassa National park. In addition to several globally threatened species the Afar Region is particularly important for the restricted range bird species, Yellow-throated Serin. It also supports at least 40 Somali-Massai biome species and provides a flyway for palacarctic and African migrants.

Yangudi-Rassa National park is a home for Wild ass, one of the endemic mammals of Ethiopia.

5.4.5.3 Amhara Region

Amongst a number of unique ecological features of the Region the remarkable once are the Simen mountains National park which is a UNESCO world heritage site and Lake Tana which is the largest body of inland water in the country.

Major habitats in the region include Afro-alpine vegetation, Rocky Mountains and cliffs, deep gorges, open plateau, wetlands, forests and vast tracts of cultivated land.

The region has the gazetted Simen Mountains National park as the only officially protected conservation area and two National forest priority areas: Wof Washa and Yegof forests. Other than Simen Mountains National park, there is no area where biodiversity conservation is given particular emphasis. Three endemic mammals of Ethiopia namely Walia Ibex, Gelada Baboon and Ethiopian Wolf found in this national park.

5.4.5.4 Benishangul-Gumuz

Benshangul-Gumiz Region is stretched along the Western escarpment of Ethiopia between Gambela Region in the south, the Sudan to the West, and Amhara and Oromia Regions to the northeast and east. All of the Region, except some isolated blocks is below 2000 m and has a topography dominated by river valleys which either join the Abay River before it enters the Sudan, or exit independently. Although very little is known about the habitats for wild life and vegetation of the region, there are reports identifying the major habitat types for the region as Doqma woodland, Sudanian woodland, Palms and Bamboo and riverine forest.

One of the prospective important bird areas in the region is Dabus valley. It is expected that the region holds a number of Sudan-guinea biome species

5.4.5.5 Gambela Region

Gambela region is in the basin of the Baro and Akobo Rivers and is found in western Ethiopia in the segment where the Pibor River joins Baro River at the border with Sudan beyond Jikawo. The Region is one of the wettest and best watered in the country being endowed by the Baro, Gilo, Itang, Alwero andAkobo rivers.

The whole lowland area belongs to the wet kola agro climatic zone while the escarpment above 1500 m belongs to the wet Weina dega zone. The main habitats of Gambella Region are Adedeguoy forest, transitional rain forest, mixed deciduous woodlands and savannah, rocky areas river banks, drainage channels and open water and wetlands.

The region's vast area has been designated as part of the officially protected conservation area. In addition to Gambella National park, there are two controlled hunting areas, Jikawo and Tedo.

Gambella region has two important bird areas, Baro River and Gambella national park and is important as it host three near threatened species and very large number of water birds. The near threatened species are Shoebill, Black-winged Pratincole, and Basar Reed Warbler. The region as a whole has a rich bird fauna with around 300 species having been recorded for the

Gambella plains. An interesting feature is the presence of a range of species from both the Sudan-Guinea and Somali-Massai biomes.

5.4.5.6 Oromia Region

Oromia borders the following regions: Amhara in the north, Benshangul-Gumuz in the northwest, Gambella in the west, Southern Nations, Nationality and Peoples' in the south west, Somali in the south east, and Afar Region in the east. Oromia covers 31.1 % of the whole of Ethiopia.

The region is characterized by immense geographical diversity consisting of high and rugged contoured mountains dissected by the Great East African Rift valley. While the Region covers land elevation from lower than 500 m up to over 4300 m, 88 % of the land area is within 500-2500 m. The most important habitat type of the Region are the following: Afro-alpine moorland, forests, grass lands, shrubs and savannah, river valleys and swamps, lava flows and other outcrops including the vast tracts of cultivated land.

There are three National Parks in the region, namely Abijatta-Shall, partly Awash and Bale Mountains and more than eight other conservation areas.

Oromia is rich in wild life. Among the most notable, the mountain Nyala and the Giant Mole rat are found in the Bale mountain National Park. Further more, 11 of Ethiopia's endemic wildlife species and two endemic sub species are recorded from the Region. The region also shares the two endemic mammals, Gelada Baboon and Ethiopian wolf with the Amhara Region.

Oromia also holds the largest number of important bird areas. There are 29 IBAs confined to Oromia Region and two others are shared with Addis Ababa and Afar Regions. Generally there are 22 globally threatened species of birds in Oromia.

The Region's diverse habitats and particularly the lakes of the rift valley attract large number and Varity of Palaearctic and African migrants. For instance some 25,000 Lesser Flamingoes have been recently observed at green Lake at Debrezeit. The famous Abijatta-Shalla National Park, known for its large number of flamingoes and other greatly diverse bird species, is the most notable one among the wetlands of the Region.

5.4.5.7 Somali Region

The Somali Region is at the Eastern lower part of the Eastern plateau of Ethiopia, which is to the southeast of the Great African Rift valley.

Biologically, the Somali Region is one of the most interesting parts of the country, containing the most varied assemblage of vegetation types and flora and fauna associated with them. It is the part of Ethiopia with highest number of endemics in spite of being one of the least studied Regions of the country.

The Somali Region holds one of the three globally endemic Bird Areas, the Juba and Shebelle Valleys. It is identified by the occurrence of Degodi Lark, Little Brown Bustard, White-winged Dove, Somali Short-billed Crombec and Juba land Weaver.

The Region has two IBA sites, Bogal Manyo-Dolo; and lower Wabi Shebele River. These sites hold four globally threatened, three restricted range and more than 50 Somali-Massai species.

In spite of being floristically and faunistically one of the most interesting parts of the country, there is not even one protected area in the Region, except for the southern parts of Babile Elephant Sanctuary.

5.4.5.8 Southern Nations Nationalities and Peoples Region

The Southern Nations and Peoples Regions' is home to many divers peoples and cultures covers about 13 % of the land and is found in the south eastern quadrant of Ethiopia.

The Region shares borders with Oromia in the north and East, with Kenya in the south, with Sudan and Gambella in the South-West and West. The area is highly variable with altitude ranging from 350 m at Lake Turkana on the border with Kenya to over 4000 m on the Gugi Mountain. The Region is dissected by the Rift valley and Omo river systems.

All agro climatic zones are found in the Region from Berha (hot arid) around Lake Chew Bahir and Turkan to Wurch (cold moist temperature) on the Guge Mountain. However, much of the Region falls in the Woinadega (warm to cool semi-humid), and Dega (cool to cold humid) zones.

The Region holds series of Lakes in the eastern side and natural forests in the central and western parts of the Region.

The major types of habitat and IBAs of the Region are forests, Wetlands and lakes, acacia wood land, bush land and thickets, riverine forests, river banks, savannah grass land and open grass land. Ten definite IBAs have been identified as occurring in the Region.

The endemic Nech sar Nightjar is restricted to only one of the IBA sites situated in the region. The other endemic recorded in the Region are Abyssinian Wood Picker, Abyssinian Long claw, Abyssinian Cat bird and Black headed Skin. The Region further holds a number of highland and Somali-Massai biome species in addition to providing wetlands of international importance regularly holding 20000 or more water birds.

The region holds three national parks namely, Mago, Nechisar and Omo and two wild life reserves and seven controlled hunting areas, which are the richest in wiled life through out the country, facing serious environmental problems which stem from increasing population pressure.

5.45.9 Tigray Region

Tigray is the northern most Region of Ethiopia, lying between latitudes 12o 17; N and 14o 52 ' N and longitudes 36 o 25 E and 41 o 49 ' E. The topography of Tigray is determined by the state of erosion of the overlaying volcanic rocks by the north western slant of northern Ethiopian massif, and by the orographic features associated with the formation of the great African Rift Valley.

The most important habitats in the region, with respect to wildlife, are broken up and often forested or at least wooded escarpments, lakes (both artificial and natural), deforested high mountains, cultivated areas, and river valleys, especially the Tekeze valley.

Four IBAs have been identified in the Region. These are Lake Ashenge, Desa'a forest, Hugumburda-great Kahsu forest and Shire lowlands (Tekaze valley). Additionally, part of the Central Ethiopian Highland Endemic Bird area comes into northern Tigray. This EBA is identified by the occurrence of Rupell's Chat. The Ethiopian endemics which have been recorded for Tigray include Abyssinian Catbird and Black headed Siskin with further five species endemic to Ethiopia and Eritrea. More over the region has wetlands which host large numbers of Palaearctic migrants during the winter months. Another interesting features of Tigray is the occurrence of birds from all the three biomes; Highland, Somali-Massai and Sudan-Guinea.

5.6 Constraints on Terrestrial Ecosystem

5.6.1 Population Growth and Poverty

Over population and poverty make natural resource conservation extremely difficult. The poor either directly utilize wildlife for food or convert the habitats into food producing fields or harvest for cash, for instance, through charcoal making or fuel wood production. The recent devastation of acacia woodland around Lake Abijata by the disbanded ex-servicemen is a living example. The population growth of the country is about 2.9 %, which is quite alarming. The rural poor directly rely on Mother Nature for livelihood. Some social groups fully relay for their animal protein on bush meat and fish. These hunters are not using their indigenous hunting tools any more. They are armed with automatic firearms that simplify hunting. This situation very well explains the reasons for the quick disappearance of wildlife even in the far and remote parts of the country.

5.6.2 Poor Farming System

Ethiopia is an agricultural country with a long history of cultivating land. This is especially true for the northern part of the country which is witnessed by its present heavily eroded landscape with bare rocks. 85 % of Ethiopians are rural inhabitants living from agriculture either engaged in mixed farming or pastoralism.

In response to their food and cash needs, peasants and pastoralists grow crops or rear livestock which normally require expansion to cope up with the increasing human population. This activity naturally involves slash-and burn in forested and heavily wooded areas which meet short-term survival needs but rapidly exploit the local ecosystem and reduce the diversity of plants and animals.

Devoid of their natural food, some of the wildlife becomes crop-raiders resulting in conflicts with the peasants. This usually ends up with wildlife death or migrations due to the pressure from the peasants.

Traditional livestock production in Ethiopia is economically not very efficient as the pastoralists keep a huge population of livestock either for prestige or security against drought spells. This has two obvious disadvantages. The huge cattle population puts pressure on the rangelands

affecting the plant and the soil on one hand and a big capital of money is tied up in a standing crop of livestock with uncertain future on the other hand.

5.6.3 Commercial Land -Use Activities

Habitat clearance and alteration for cash crop production, deforestation for timber trade, and mining are examples of activities which can and have contributed to irreversible habitat destruction and total loss of species, particularly invertebrates, most of which might be unknown to science.

Soda ash mining which started on Lake Abijata National park in 1990 has resulted in polluting the lake water affecting the loss of algae that supported the fish. As the fish died out due to lack of food, the pelicans that feed on the fish left the place. Lake Abijata used to supply food for the pelican nesters on the neighboring islands of Lake Shalla, which is one of the seven nesting sites of the great white pelican in the whole of Africa.

5.6.4 Climate Changes

One of the greatest threats to natural system is climate change, brought about locally by changing regional vegetation through poor resource and fire management and globally by pollution and increased carbon dioxide and fossil fuel burning.

The cycle of recurrent drought in Ethiopia, which is effected by climatic change has some contribution to the decline of wildlife population through starvation.

5.7. Indicators for Evaluation and Monitoring of Terrestrial Ecosystem

5.7.1 Definition of Terrestrial Ecosystem Indicators

Terrestrial ecosystem indicators are indicators, which give us information about the change and trend of terrestrial environment. They are used to quantify, communicate and create order within complex data. They provide information in such a way that policy makers and public can understand and relate to terrestrial ecosystem. Indicators help us to monitor progress and trends in the use and management of terrestrial ecosystem over time and space. Similarly, these indicators can help us to compare results in different areas or countries and examine potential links between changing conditions, human behavior and policy choices concerning the terrestrial ecosystem. They are also help to compare actual situation with the desired or planed state. Because good indicators are easy to understand, they offer a tool for raising awareness about terrestrial ecosystem that cuts across every social and political group.

5.7.2 Criteria for the Selection of Good Indicators

- Indicators can be either descriptive or normative
- They may indicate quantitative or qualitative information
- Indicator should enlighten its user and provide a sense of the issue being examined.

- Indicator can be a simple data point or variable, or can be a simplified value derived using a complex mathematical algorithm
- Indicators should be comparable in time and space
- They should be understandable and capable to measure changes and trends clearly
- The numerical value of an indicator should represent the degree of what should be measured directly
- Ambiguity and arbitrariness should be excluded from measuring with indicator
- The cost of the evaluation by indicator should be affordably low
- Indicator should be easily comprehensible to use

5.7.3 Proposed Indicators for the Terrestrial Ecosystem

The following indicators are proposed to monitor the sustainability of terrestrial ecosystems in Ethiopia:

- Number of protected national parks in the country
- Number of protected wild life reserve areas in the country
- Population increase or decrease of the known endemic animals in a given National Park
- Number of forest priority areas with management plan
- Percentage forest cover of the country
- Number of research institutes on forest and biodiversity
- Number of Federal organizations with EIA units in their organizational structure
- Number of regional governmental organizations with EIA units in their organizational structures
- Increasing or decreasing in numbers of endangered bird species
- Number of protected important bird areas in the country

Indicators	Current (2004) data unless and otherwise it is stated
• Number of protected national parks in the country	10
• Number of protected wild life reserve areas in the country	8
• Population increase or decrease of the known endemic animals in a given national park - Number of Walia ibex in Simen National Park - Number of Chilada baboon in Simen National park - Number of Elephants in Babile Elephant Sanctuary	 539 10,000 100 (in 1990)
• Percentage forest cover of the country	3 %
• Number of forest priority areas with management plan	3 (Munessa-Shashemene, Tiro-BoterBecho and Menegasha-Suba)
• Number of endemic mammal species in the country	22
• Number of research institutes on forest and biodiversity	4
• Number of Federal organizations with EIA units in their organizational structure	2(ERA & EPCO)
• Number of regional governmental organizations with EIA units in their organizational structures	7
• Increasing or decreasing in numbers of endemic bird species	16
• Increasing or decreasing in numbers of endangered bird species as compared to the current state	5

5.8 Strategies to Arrest the Current Degradation of the Terrestrial Ecosystem

- Establish sustainable land use system in all the regions
- Classify cultivable and non cultivable land based on the slope classification
- Promote agro forestation in the farmer's holdings and communal areas
- Conserve the existing forest cover of the country

- Reduce soil erosion through water shed management
- Improve National wildlife park management and create awareness among local people about the conservation of wildlife and make the local people living near the parks direct beneficiaries of the parks

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Chapter 6

6 Water and Settlement

6.1 Definition of Urban and Rural Settlements

At the time when the 1994 Ethiopian population and housing census was conducted, a definition for urban center has been given. Urban center was therefore defined as " a locality with 2000 or more inhabitants and in addition, all administrative capitals of regions, woredas (local administration) other localities where Urban Dwellers Associations, commonly known as 'Kebeles' were established are known as urban areas". No matter whatever size of population they have in as much as they have some sort of administrative significance, no other parameters have been stated as such. However, according to Ministry of Water Resources, Urban settlement category is defined as those towns with a population of 2500 and above.

From the above definition for urban center, one can understand that the definition is based on population size and the locality's administrative significance.

Settlement categories outside those defined as urban centers are to be grouped in a settlement locality to be known as rural areas, where homesteads are very much scattered over a wide area, usually close to the land that each family owns.

6.2 Urban and Rural Population

The Central Statistical Authority (CSA) is Government's specialized and responsible institution for data and information mainly related to social, cultural and economic aspects of the country. This Government agency issues Statistical Abstract related to population settlements by age group, sex, urban and rural. Data presented here regarding the urban and rural population (past, current and future) are therefore based on publications furnished by this same agency. Accordingly, we refer to the 1994 Population and Housing Census as a basis for comparison between the past and the present and also with what is projected for the future. According to the 1994 population census, the total population of Ethiopia was 53,477,256. If we further disaggregate this total population in to urban and rural, the report showed that total urban population of Ethiopia ten years ago was 7,323,122 (13.7% of the total population), while the rural population was 46,154 058 (86.32 of the total).

Projected population size of Ethiopia after ten years (i.e. July 1/2004) according to the same source, the Central Statistical Authority's Statistical Abstract is 71,066,000 and that is an increase of 17,588,735 (32.89%). In ten years time urban and rural population has increased to 11,199,000 and 59,867,000 respectively.

By the year 2015 the total population of Ethiopia is projected to become 93,991,777, out of which 17,011,383 and 76,980,394 respectively are for urban and rural areas. This shows eleven years from now; the Ethiopian population is going to increase by 22,925,177 (32.26%).

Average national population density for the above specified census year was 47/km², but according to the projection for the years 2004 and 2015 population densities are 63 and 83 respectively, for more information and knowledge about urban and rural population past, current statistics and future projection please see the table below.

Table 6.1: Projected Population of Ethiopia by place of Residence

Years	Urban	Rural	Total	Population Density
1990	6,580,131	41,470,869	48,051,000	39
1991	6,859,502	42,584,977	49,444,479	40
1992	7,058,428	43,819,941	50,878,369	42
1993	7,263,122	45,090,720	52,353,842	43
1994	7,323,207	46,154,058	53,477,265	47
1995	7,638,105	47,418,679	55,056,784	49
1996	7,966,543	48,717,951	56,684,494	50
1997	8,309,105	50,052,823	58,361,928	52
1998	8,666,396	51,424,270	60,090,666	53
1999	9,039,051	52,833,295	61,872,347	55
2000	9,427,731	54,280,927	63,708,658	56
2001	9,814,267	55,675,947	65,490,215	58
2002	10,216,652	57,106,819	67,323,472	60
2003	10,635,535	58,574,464	69,210,000	61
2004	11,071,592	60,079,828	71,151,420	63
2005	11,525,527	61,623,880	73,149,407	65
2006	11,993,464	63,072,041	75,065,505	66
2007	12,480,398	64,554,234	77,034,632	68
2008	12,987,103	66,071,258	79,058,361	70
2009	13,514,379	67,623,933	81,138,312	72
2010	14,063,063	69,213,095	83,276,158	74
2011	14,608,710	70,701,177	85,309,887	75
2012	15,175,528	72,221,252	87,396,780	77
2013	15,764,338	73,774,009	89,538,347	79
2014	16,375,994	75,360,150	91,736,145	81
1015	17,011,383	76,980,394	93,991,777	83

Source: Extracted from population and housing census of Ethiopia, Result at country Level Vol. 11 analytical Report, June 1999, Addis Ababa, Ethiopia.

Table 6.2: Population Growth Rate Projection

Item	1995-2000	2000-2005	2005-2010	2010-2015
Urban GR	4.38	4.1	1.06	3.38
Rural GR	2.74	2.57	2.35	2.15
National GR	2.92	2.73	2.62	2.44

Source: population and Housing census of Ethiopia, Result at country level, vol. 11

The population census, the current statistics and the future projections consistently and persistently show that the majority of the Ethiopian population is rural and its economic mainstay is agriculture. High population concentration is found in the highlands, where climatic conditions are more favorable for life and crop cultivation. However, the Ethiopian lowlands though they consist the larger portion of the country, they are still sparsely populated by people due to a number of diseases like vector born diseases, particularly, Malaria, the deadly killer of

most people living in these areas. Only 19% of the total populations are known to live in the lowlands that are consisting 55% of the total area of the country.

The farmers living in the Ethiopian highlands are predominantly engaged in agriculture, livestock rearing and minor off-farm activities. They are organized under what we call Peasants Associations, while those in the lowlands are primarily engaged in nomadic pastorals, where they are moving from place to place in search of animal feed and water and in some areas there are sedentary farmers and semi-agriculturalists.

6.3 Access to Improved Water Supply

The proportion of people at national level with access to safe water supply, according to recent publications is only 34%. If we consider separately the rural and urban settings, the rural situation is more disappointing as it is only 25% while the urban coverage is 85%, but if we take out Addis Ababa, the capital city, the situation in the rest of urban centers is still low.

6.3.1 Water Loss Due to Leakages in Infrastructure

Loss of water produced due to system failures, inefficiencies, poor maintenance and other reasons is considered to be one crucial issue affecting the supply of water to users.

Data that cover many of the systems in the country are not available at the moment. However, the case of the city of Addis Ababa could fairly tell the overall situation.

In order to tackle the problem of water loss due to leakage, a study was carried out on treatment plants, service reservoirs, distribution systems, water meters, etc. with the objective of finding out the level of loss or the amount of water wasted and find out a solution to reduce the problem. Accordingly, more than 40% water produced by the Addis Ababa Water Supply and Sewerage Authority (AAWSSA) was lost and wasted due to mainly leakages.

Recent reports of this same public water utility show that the level of unaccounted for water has been reduced from 40%in December 2000 to 35% at present currently. The City Public Water Utility has further planned to reduce the current 35% of water loss due to mainly leakage to 25% in ten years from now, i.e. 1% every year.

It is generally believed that the level of unaccounted for water in the rest of the urban centers may not be any thing better than Addis Ababa, except for systems that have been established recently or in the case of those water supply systems that are new.

6.4 Access to Sanitation Services in Urban and Rural Settlements

Except Addis Ababa and a few urban centers in the country sanitation facilities are basically non-existent.

Sanitation in general and sewerage in particular is a neglected sector on a countrywide scale; especially the urban sewerage poses a serious concern in a situation where urban population is increasing very rapidly. Present condition really harbours the threat of major epidemics.

There are no piped or modern types of sewerage systems in the towns of the country except for a small part of the city of Addis Ababa.

Sewerage technologies that require use of water are considered in the National Water Policy of Ethiopia and plans are also included for urban sewerage in the 15-year Water Sector Development Program (WSDP). The national sanitation coverage is currently reported to be not more than 17%, whereas the situation for the rural areas is far more below this statistics.

Regarding latrine status in Ethiopia, the World Bank- Water and Sanitation Programme(Africa) produces data in the table below, using CSA's sources.

Table 6.3: Defecation practice- Ethiopia 2000

Facility	Country	Rural	Urban
Flush toilet	1.7%	0.8%	7%
Pit latrine	16.3%	8.1%	64.6%
Container	0.1%	0.0%	0.7%
FICCB/fores	81.5%	90.7%	29.9%
Other	0.5%	0.8%	0.8%

Source: Sanitation strategy paper, 2nd draft September 11,2004

Sanitation coverage, according to the 15-year Water Sector Development Program is expected to increase annually by percentage points of 3.5 from its level of 7% in year 2000 (MOWR, WSDP Report 2002)

6.5 Poverty (Urban and Rural)

Recent data on poverty and other useful indication of poverty are reported to have been made available by the Ministry of Finance and Economic Development (MOFED) from its Welfare Monitoring System and data on income poverty from the National Household Income Consumption and Expenditure (HICE) survey that were carried out by the Central Statistical Authority (CSA) in 1995/96 and 1999/2000. Accordingly, most data that are used here are obtained from a report of MOFED that had been compiled and analyses made using the above main sources (MOFED 2002).

Sample households covered in the welfare monitoring are known to have increased from 11,500 in 1995/96 to over 25,900 in 1999/2000), while the 1999/2000 HICE covered more than 17,000 households and as reported most of them were also covered by the WM survey. In the Household Income Consumption and Expenditure Survey, total expenditure was used as the main money measure of a typical household welfare.

The trends in expenditure and income poverty are generally considered as good measures for the welfare of households. But, it is still important, to take note of that many other factors can affect the level of poverty at any one time, among which, weather (especially drought), war, certain external shocks which might include sharp rise in commodity prices could affect the ability of households to buy their basic requirements with the income they have.

If as discussed earlier, expenditure and income are considered, according to HICE survey for the year 1999/2000, the mean per capita consumption expenditure of Ethiopia is estimated to be Birr 1057 in constant prices of 1995/96. The real per capita consumption expenditures for rural areas and urban centers for the year indicated were Birr 995 and Birr 1453 respectively.

For better appreciation of the situation by those readers of this report which are not quite familiar with the national currency's convertibility status, the level of the real per capita income expressed in Birr were equivalent to USD139, 131 and 191 for the national, rural and urban respectively, and this was based on the 1999/2000 annual market exchange rates. According to this report, poverty incidence was much higher in the rural area than it was in the urban centers of the country. It is reported that the poverty head count percentage points or indices in rural areas and urban centers were 45 and 37 percent respectively in 1999/2000, the latest survey available for this purpose.

Although the two surveys indicated that the food share in rural areas increased from 60% in 1995/96 to 67% in 1999/2000, while food share in urban areas declined from 56% to 53% during the same period, the increase in calorie content of the consumption basket was agreed that it never showed that there is a change or an increase in food quality.

MOFED's report further emphasized that the fact that a high proportion of their budget is allocated to basic food consumption in the rural areas still indicate that people are food insecure.

In order to give clearer picture of the trends in poverty using the real consumption expenditure and calorie-intake in both rural and urban centers, the data in the table below is here furnished.

Table 6.4: Trends in Real Consumption Expenditure and Calorie Intake

	1995/96			1999/2000		
Items	Rural	Urban	National	Rural	Urban	National
Real food expenditure per capita	577	790	607	609	631	612
Real Non food Expenditure per capita	466	625	488	392	830	451
Real total Expenditure per capita	1035	1411	1088	995	1453	1057
Kcl consumed per day per adult	1938	2050	1954	2723	1861	2606
Share of food in total expenditure	0.6	0.56	0.6	0.67	0.53	0.65
Household size	5.1	4.7	5.0	4.9	4.6	4.9
Adult equivalent household size	4.2	3.9	4.2	3.9	3.8	3.9
Gini. Coefficient	0.27	0.34	0.29	0.26	0.38	0.28

Source: MOFED June 2002. Poverty Reduction Strategy Program (PRSP) document

As the table above shows, the overall consumption and income inequality in both rural and urban areas are not significantly high. The overall Gini coefficients for the years 1995/96 and 1999/2000 were found to be 0.29 and 0.28 respectively.

Expenditures are dependent on the level of income, therefore as the table above shows for the 1992/2000-income inequality in urban areas appears to be a bit higher than in the rural areas, which is 0.26. The fact that the level of inequality in income and consumption in Ethiopia is low indicates that Ethiopia is generally a poor country with a low per capita income. It is sometimes argued that one of the reasons could be the egalitarian type land holding system in the country, which caused the more or less equal income distribution in the rural. Although changes in inequality are observed in the Gini coefficient indicated in the table above, they still are not that high or significant. However, a small decline in Gini-coefficient between 1995/96 and 1999/2000 has been observed that inequality in income in the rural areas has declined from 0.27in 1995/96 to 0.26,in 1999/2000, whereas a small increase is observed in the case of urban areas in between those years (i.e. it rose from 0.34 in 1995/96 to 0.38 in 1999/2000). Statistically

speaking the change observed in the inequalities in both rural and urban areas is not that significant.

In the years under consideration, the proportion of people in Ethiopia whose consumption expenditures were less than what is called total poverty line and those who were also absolutely poor were 44% in the 1999/2000 From the same source, the proportion of people who were at that time classified as poor were 37% in urban centers and 45% in rural areas, which indicated that rural poverty is higher than Urban poverty.

Another table is presented below to show the trends in poverty head count indices by area of settlement (Rural and Urban).

Table 6.5: Poverty Head Count Indices (1995/96 and 1999/2000)

Location	1995/96	1999/2000	% Change over 1995/96
Rural	47.0	45.0	-4.2
Urban	33.3	37.0	11.0
Total (National)	45.5	44.2	-2.9

Source: MOFED June 2002, PRSP Report.

Poverty head count indices for the rural areas have shown a decline by about 4.2 per cent, apparently indicating that poverty has not increased in the rural areas, probably due to better harvest, while poverty head count index increased by 11 percent in urban areas. As for the national level indices have declined by about 3 per cent.

6.5.1 Public Health Issues.

According to official reports, Ethiopia is known to have one of the lowest health statuses in the world. Reason given for this is due to backward national socio-economic development, which in turn resulted in widespread poverty, low standard of living, poor environmental conditions and inadequate health facilities (MOFED June 2002). Having realized these underlying facts, the Federal Government of Ethiopia has embarked on multi-pronged poverty reduction programs. Consistent to the Federal Government's rapid economic development policy and strategy, a 20 - year rolling health development program has been developed for implementation.

Generally, the Ethiopian Health Policy gives special attention to prevention as most of the diseases in the country are water born /water related and sanitation related ones, the issue of prevention then becomes truly a priority in the context of Ethiopia.

6.5.1.1 Occurrence and Frequency of Water Related Disease

Most often statistics show that the greater portions of all diseases in the developing world are caused or are related to unsafe water, inadequate and inappropriate hygienic and sanitary practices. High infant mortality rates, low life expectancy and generally poor living standard in the developing world in general and in Ethiopian in particularly is significantly accounted for inadequate and unsafe supply of water.

The major water and sanitation attributed diseases (water borne, water related, water based, water washed, water-insect –vector related) are listed as Malaria, Yellow fever, Typhus, Relapsing fever, Tapeworm (Taeniasis), Ascariasis, Hookworm, Schostosomiasis,

Typanosomiasis, Trachoma Amoebiasis and Giardiasis, Onchoceriasis and Acute childhood Diarrhea (ACD).

About 55% of the area of Ethiopia lies in the lowlands, and these areas are known for many of the diseases and many problems that are deemed to bring about hazardous effects on ones health. Unless these lowland areas are made free of those that cause most of the diseases, they will continue to be less inhabited.

About ¾ of the total areas of Ethiopia are known to be breeding grounds for mosquitoes, the cause of the deadly killer malaria. Due to this situation about ⅔ of the population living in the lowlands of the country are always at risk of such infectious disease Most of the population in Ethiopia are therefore concentrated in the highlands, which are not as such exposed for diseases as to the widespread occurrence of malaria in the lowlands. Malaria and other similar problems are therefore the root causes for sparsely populated conditions of these areas. In areas of the country with mean altitude less than 1500 meters above sea level and annual average total rainfall less than 900mm and mean temperature of 20 to 30ºc, the deadly killer malaria is endemic. The highly malarious areas to mention some are Humera, Metema, Metekel in the N.West and West of the country, Gambella in the southwest, Gode in the East of Ethiopia and the Awash Valley.

Even in the temperate zones of altitudes between 1500m and 2500m, where mean annual rainfall is 400 to 2400m and mean temperature is 20ºc, there is an occurrence of malaria to a lesser degree, mainly in those areas that are below 2000m altitudes.

That quantification of morbidity and mortality rates strictly related to water borne or inadequate and unsafe water supply has not been found easy. This problem was mainly attributed to the lack of effective monitoring and surveillance system and countrywide base line surveys. However, available data and information on the prevalence and occurrence of diseases indicate that water borne or water-related diseases are among the major cause of sickness and deaths. Diarrhea, which is major water related disease accounts for 46 % of under-five child mortality. As women and girl children are the main social groups that fetch water to the family, their frequent contact with contaminated water has made them to be most exposed to water related diseases. They are the most vulnerable ones to water borne or water related diseases in general.

According to the Statistical Abstract (2003) of the Central Statistical Authority, of the top leading causes of Hospital and Health Centers morbidity for the year 2002/2003, malaria is the main one for all the causes with the percentage points indicated for the regions of Afar, Amhara, Benishangul Gumuz, SNNPR, Gambella, and Somali as 36.2%, 35.9%, 30.6%, 26.5% and 10.8% respectively. These are regions of the country with vast areas of lowlands.

Data regarding contamination that are resulting from waste water discharges have not been found for the moment and discharge load by sector, i.e. from industries, agriculture and domestic source are also found very difficult to report for the purpose of this assignment due to lack of data.

6.6 Effect of Water-Related Natural Disasters

Most if not all-Ethiopian rivers flow in deep gorges in which the flowing water is very much protected or trenched from overflowing. However, it should be noted that there are several

areas, which are prone to flooding. Some of the places that are known for these phenomena are the Tana shores of the Abbay Basin (Blue Nile), the lower reaches of the Wabe Shebele in the East and South East of the country and the vast plains of Baro Akobo Basin in the south west of the country in the Gambela Administrative region.

6.6.1 Floods

In addition to these areas, floods in the Rift-valley Lakes Basin tributaries, the Awash Basin, which is not as such located or is flowing in deep gorges like the rest of the rivers causes occasionally flood problems.

Floods in the areas specified above occur more or less every year, but the extent to which they pose problems are not always the same. The magnitude of the problem changes from year to year.

Another positive aspect of flood in certain aspect is related to the nomadic pasturalists, where flood brings necessary moisture to their dry season grazing lands. Theses people most often are found in the arid lowlands. Although sometimes it inflicts heavy damage on life and property of the nomadic pastoralist and other living around flood, as a source of moisture is well liked by the pastorlists.

According to DPPC, the Government Commission, which is responsible for Disaster prevention and preparedness, has officially designated the following areas in the country as flood prone areas:

- In the Somali Regional State in the east in the areas from Imi to Mustahil on the Wabe shebele River Basin.
- In the Gambella Regional state from the town of Gambella to the Border town of Jikao (Border to the Sudan):
- In the Afar Regional State in the east and north east of the country on the Awash River around the former principal Regional town of Assaita;
- In the Amhara Regional State in the areas found immediately east of Lake Tana, where the two rivers of Ribb and Gumara enter Lake Tana, one of the largest natural lakes in the world.
- In the Oromia Regional State in areas or localities known as Tefki and Teji Depression.

6.6.2 Droughts

The incident of drought generally implies substantial and long extended deviation of rainfall, which deviously affects crop production and vegetation growth. Drought for Ethiopia and in Ethiopia is a frequently recurring phenomenon. The spatial distribution and the frequency of its occurrence have increased in recent years. Drought used to hit Ethiopia at least once in every ten years in the past, but as of the last few years, it is just recurring every two or three years with different level of intensity.

According to reports to date (Workineh1987) about drought and famine, which are quite synonyms in the case of Ethiopia, there were about 30 major drought episodes over the past

nine centuries. Of these drought episodes 13 of them are known to have covered the entire nation and they were reported severe enough.

Some of the recent drought and famine years were 1972-1974, 1975/1976, 1983/84, 1990/91, 1992/93, 1994/95,1997/98, 2001/2002 and 2002/2003.

The climatic conditions of the indicated drought years were characterized by either almost total failure of rainfall, late or early onset of inadequate rainfalls during both the small rainy season and/the main rainy season known as "Belg" and "Kiremit" respectively by Ethiopians.

The effects of drought due to failure in rainfall or inadequacy of the same is shown in the table below just to show the extent to which drought affects population, which eventually leads for food hand-outs or food aid for those severely affected and are in dire need of others help.

Table 6.6: Drought Affected Population 1990-2004

Year	Population affected	Food Assistance Requirements
1990	3429900	374400
1991	1850000	8389074
1992	5228530	1288737
1993	1644040	739280
1994	889000	577586
1995	3994000	492460
1996	3153000	253118
1997	1932000	199846
1998	5820415	572834
1999	2157080	1138994
2000	7732335	836800
2001	6242300	639246
2002	5181700	557204
2003	14490318	1461679
2004	9369702	964690

Source: DPPC, EWR, 1990-2004

What are the main causes of drought in Ethiopia? The high population growth is believed to have placed increased demands on the natural resources and this is known to have led to massive deforestation and devegetation. These phenomena finally resulted in the disruption of replenishment of groundwater and climate regulation; vital ecological services of vegetation cover as control of run-off and soil erosion loss, this situation therefore led to the drought-flood cycle phenomena in Ethiopia.

The amount of soil lost is estimated at 2 billion tons per year. Technically, the consequence is massive flooding, decreased rainfall infiltration and drying up of local streams and rivers once the rainy season is over.

Local and regional deforestation has been so much accelerated over the last decades, leaving the subtle hydrological cycles that control rainfall very much disrupted.

6.6.3 The Immediate Impacts of Drought

The drought years that are mentioned earlier in this text were famine related loss of human lives and livestock, mass starvation and mass movement of starved people from their localities to relief centers and nearby towns and cities of the country.

Famine related deaths are considered to be the highest. According to one Ethiopian Nutrition Institute Repot, the 1974 famine in one of the then province of Ethiopia (Wollo province) mortality rate was 190 per thousand of those who had been affected by drought. The 1974 famine in Ethiopia is known to be one of the immediate causes of the popular uprising which led to the downfall of Emperor Haile Selassie I. Again the 1984/85 drought year is known to have claimed more than million lives (Newsweek may 20, 1991)

6.6.4 Contingency Plans

Generally speaking Emergency situation could arise when the well being of victims of natural or man made disasters are threatened unless immediate and quick appropriate emergency measures are taken by way of extra ordinary responses and actions. In a situation like this, the need or the necessity for a contingency plan becomes extremely important as a forward planning process in the state of uncertainties. Objectives and all possible scenarios are defined in an agreeable manner. The necessary leadership and management and technical action are defined and a system of responding to emergencies is put in place in order to prevent it with strength and resolute.

Ethiopia has a well-organized and experienced Government institution known as the Disaster Prevention and Preparedness Commission (DPPC), which often make contingency plans for any possible critical event. Many relevant and concerned Federal and Regional Government Agencies are required to draft contingency plans under the auspices of the DPPC. The most common events that call for contingency plans are during times that new influx or sudden increase in the number of people leaving their localities or villages as a result of drought which impacted on their harvest and are striving to escape eminent danger or hunger, which may finally entail the loss of many lives of the people and livestock it is not managed properly.

As mentioned above all concerned Government and non-Government organizations are involved in the process of developing contingency plan and are usually brought together by DPPC to draw a common agenda and objectives and finally draft a plan of actions to be implemented by all, where DPPC will monitor and evaluate the pace at which each participating agency is delivering whatever is expected of it.

6.7 Population Movement

According to CSA's definition for urban and rural settler, "A person who was born in a rural area of a given Woreda (locality) of enumeration and has been continuously residing there is considered as a non-migrant, otherwise he is considered as migrant. A person who was born in a given town and has been continuously residing there is considered as a non migrant, otherwise he is considered as migrant". (CSA, 1994)

The growth in population size of urban centers could occur due to internal rural urban migration, the natural increase of the urban dwellers, which are defined as non-migrants and sometimes

the one time rural localities could become segments of urban center due to the expansion of urbanization. With urbanization there is a change in the proportion of population living in urban centers, normally it rapidly increases.

In the context of Ethiopia rural- urban migration is known to be high. As people are forced to leave their localities during droughts and other natural and man made calamities, the place where they take refuge are normally the nearby towns and cities. The young rural people always move from their place of birth to urban centers in search of opportunities such as education and better living condition. In general the dominant type of migration in Ethiopia is Rural-rural (north-south) this has remained to be the reality up to very recent times. The Ethiopian highlands found in the north are very populated where the carrying capacity of land in these areas are very much saturated calling for people to move south wards in search of better living conditions and land to till or other off farm activities. According to some sources migration in Ethiopia is said to be moderate, only 9.2%.

Recorded information about rural urban migration has been done during the 1994 population and Housing census, which is the latest one in this regard.

Accordingly, excluding urban centers in Afar and Somali regions, the total population in the urban areas in the specified census year was 6,767,068 of these 44.7% (3,025,690) were migrants and of the total migrants close to 57% (1,714,682) were migrants from the rural areas. In relative terms the urban-urban migration is dominant one, that is to say although the people moving from one urban center to another urban center are few compared to those coming from rural areas, but as they migrating from small portion of the total population of the country, no matter how small their number is, in percentage terms it is still significant.

The following table is here presented in an attempt to show the rural urban movement of people in Ethiopia with the exclusion of urban centers found in the Afar and Somali regions.

Table 6.7: Urban population by sex, migration status and area of previous residence, 1994 (All regions except for urban centers of Afar and Somali regions)

Sex	Migration status				Area of previous residence		
	All persons	Non-migrants	Migrant	Not stated	Urban	Rural	Not stated
Male	3,231,593	1,773,640	1,436,910	21043	632,698	801433	2,779
Female	3,535,475	1,925,885	1,588,780	20810	672,450	913,249	3,081
Total	6,767,068	3,699,525	3,025,690	41853	1,305,148	1,7114,682	5,860
Proportion of the total	100	54.7%	44.7%	0.6%	19.3%	25.3%	0.1%

Source: CSA 1994 population and Housing census.

The same census report showed that there was to some extent movement of people from urban centers to rural areas. Again, excluding the rural areas of Afar and Somali regions the total population of rural areas in Ethiopia was 42,132,203 (CSA 1994) of these 9.2% (3,890,963) were migrants. Of the then total migrants about 13% (507,395) were people who moved or migrated from urban centers to the rural areas. The table below would show the whole picture in this regard.

Table 6.8: Rural population by sex, migration status and area of previous residence (Excluding rural areas of Afar & Somali)

Sex	All Persons	Migration status			Area of previous residence		
		Non migrant	Migrant	Not stated	Urban	Rural	Not stated
Male	21,161,077	19,326,851	1,757,513	76,713	293,444	1,462,029	2,040
Female	20,971,126	18,764,131	2,133,450	73,545	213,951	1,917,369	2,130
Total	42,132,203	38,090,982	3,890,963	150,258	507,395	3,379,398	4,170
Proportions of the total	100%	90.4%	9.2%	0.4%	1.2%	8.0%	0.0%

Source: CSA 1994

6.8 Urban Development and Water Management

Urban development and water management in present-day Ethiopia are two most important and inseparable social and economic issues attracting appreciable level of concern of Government and its partners.

Until the last few years urban development and growth was not really taken as a serious issue that has an impact in the all rounded socio-economic development of the nation. Cities and towns most often are established not as results of thoughtful plans and assessment or as an integral part of national economic and social developments, but they were just created here and there without any articulated plans or sometimes with minor Urban planning exercises.

Since the past few years, may be five years or so, cities and towns have embarked on taking the responsibilities of planning, managing and effectively acting on social, economic and investment issue pertaining to their respective localities.

Municipalities and other necessary management or administrative structures of the urban centers have been created. City councils and council of advisory representative bodies are created and consulted over the issues that the general public wants to be addressed. Cities and towns are closely working with NGOs, and international multilateral agencies, bilateral donors and private sector in particular. Investment incentive are provided in various forms to those who are interested to join hands in the advancement of cities and towns within the development framework approved and endorsed by the government and cities /towns representative.

New institutions are being created and existing ones are being strengthened, among which the various town water supply services, big public Water Utilities, Water boards and Water committees are to be mentioned most for our purpose.

6.8.1 Water Demand Management

Water Demand management is generally the use of price, quantitative restrictions/quotas and other means such as leakage detections, Generally tariff structures according to the Ethiopian Water policy are site specific and are determined according to local circumstances (Ethiopian water policy, 1999). The same water policy also advocates that tariff structures (Water prices) should be based on equitable and practical; guidelines and criteria. Consistent to the application of water demand management, the Ethiopian Water Resources Management Policy strongly emphasizes that tariffs should neither be too low leading to the abuse of its use nor should it be too high discouraging consumption. The parties that are involved in the decision

making process of tariff setting are obliged by law and policy that tariffs should be set based on the circumstances prevailing in the city or towns in question. Therefore, as the supplies of clean and safe water in most of the urban center are not available in abundance, prices have started to operate in order to manage an extravagant manner of using the scarcely available Water. Tariff rates are strictly linked with the rate of consumption. However, the tariff rates introduced are not developed without scientific studies and assessment. Participation of the users, especially Elected representatives of urban dwellers are in one way or the other involved in this process.

The other instrument used in demand management in Ethiopia, mainly with Water supply services that are in short supply is to provide water in rounds or turns. In how many days would any segment of a community get that services is not the same for every scheme, it depends on the amount of Water produced. In the case of severe shortages, households could be forced to wait for more days before they get any amount of Water from the service provider, and in some cases it could be either in the afternoon or in the morning or a matter of hours. It is not therefore uncommon in the case of some towns to see people going in search of unsafe water, which eventually would lead to badly affect their health condition. Quotas determined on the basis of head counts or any other manner is not common. Especially in the case of yard or house connections, once the water is there you might use to any extent you like.

6.8.2 Decision Making Mechanisms

Water supply services in most towns and cities in Ethiopia are organized in either ways of the following

Urban Water Supply Services are established by Government proclamation in many of the big cities and towns found in Regions. They are autonomous to plan, develop and operate, within the legal and policy provisions that they are required to do so;

Certain Urban Water Supply Services are under municipalities with a leverage to plan and operate in a business like fashion;

In other cases there are Water Boards and/or Water Committees responsible for the management of Water systems in their respective constituency.

The Addis Ababa Water Supply and Sewerage Authority (AAWSSA) as the biggest Public Water Utility available in the country provides water to almost 3 million inhabitants of the city.

In all the cases mentioned above, the role of Government representatives is significantly high. Which ever of the management types mentioned above are taken, the various Management Boards are chaired either by Mayors or Town Administrators. The Assumption is that majors and/or towns Administrator are elected people's representatives. But, members of the Water Boards Water Committees and the Management Board of the big public water utilities are also drawn from organizations that are considered to represent the general public and also representative from the social and economic entities that are believed to have a stake in the over all plan, development and management of the Water systems.

According to the EWRMP, in order to enhance readiness to pay and ensure transparency in the financial management and fair and balanced services, users and communities are required to participate in the management of the systems.

Generally, the Water policy promotes that a full participation of users is very important for an effective decision making at the lowest practical level. But in view of the social and economic complexities prevailing in the urban centers, the decision making process could be through elected representative in Government and associations organized to meet and support certain social and economic demands of respective urban communities.

The general public is therefore participating in different ways in the development of urban centers and in Water demand management. Urban dwellers in Ethiopian are organized in to Town Dwellers Associations at various levels, now becoming the sole administrative structures to manage their own social and economic affairs with the support of many stakeholders that are interested to work closely with the municipalities and their branches organized at different levels, including at local levels.

These Urban associations are administratively autonomous to budget, plan, implement and operate within the limit of resources available to them from all sources, including communities' contribution either in cash or other forms.

6.8.3 Pricing Policies

As discussed earlier Water prices in general are set according to circumstance of the project area. Water prices or tariffs are not set uniformly across the board. Water prices or tariff structures in Ethiopia are site-specific. A meticulous tariff study is to be conducted before any decision is to be made. The study on tariffs be it for big cities and towns or small ones, the ultimate beneficiaries are needed to be consulted in accordance with the policy provisions set for the sake of sustainable, transparent and fair services of the systems.

With regard to Water Supply and sanitation services, the commanding principle issued in the Ethiopian Water Resources management policy is that the "User pays principle", especially for Urban Water supply and sanitation services.

The policy further states that the "User Pays" principle should carefully be harmonized with the ability and willingness to pay principles.

While rural tariff settings are based on the objectives of fully meeting the operation and maintenance costs, urban tariff structures (Water prices) are based on the basis of full cost recovery (i.e. costs for investment and M&O cost). But the reality is not so. The issue of full cost recovery for all urban centers with a population of 2500 and above has really become difficult. Therefore, there is no single urban center that has so far implemented the pricing policy provided by Government. It seems that it will take some time before urban towns are able to stand on their own feet. In any case, it is the country's present policy that every effort should be made to commercialize the management of Water supply system in cities and towns of the country with the full participation and involvement of all relevant stakeholders, including the beneficiary communities.

6.9 Indicators

Challenge Area: Water and Settlement

Water and settlement Indicator (WSI}

01: Proportions of peoples living in urban and rural areas of Ethiopia

YEARS	URBAN %	RURAL %	NATIONAL POPULATION DENSITY PER/KM2
1990	13.69	86.31	39
1991	13.87	86.13	40
1992	13.87	86.13	42
1993	13.87	86.13	43
1994	13.69	86.31	47
1995	13.87	86.13	49
1996	14.05	85.95	50
1997	14.23	85.77	52
1998	14.42	85.58	53
1999	14.61	85.39	55
2000	14.80	85.20	56
2001	14.99	85.01	58
2002	15.18	84.82	60
2003	15.38	84.62	61
2004	15.56	84.44	63
2005	15.76	84.24	65
2006	15.98	84.02	66
2007	16.20	83.80	68
2008	16.43	83.57	70
2009	16.66	83.34	72
2010	16.89	83.11	74
2011	17.12	82.88	75
2012	17.37	82.63	77
2013	17.60	82.40	79
2014	17.85	82.15	81
2015	18.10	81.90	83

WSI 02: URBAN and Rural Population Growth Rates

	1995-2000	2000-2005	2005-2010	2010-2015
Urban Growth Rates	4.38%	4.1%	1.06%	3.38%
Rural Population Growth Rate	2.74%	2.57%	2.38%	2.15%
National Population Growth Rates	2.92%	2.73%	2.62%	2.44%

WSI 03: Percentage of unaccounted for water for the city of Addis Ababa.

As of December 2000 the total loss of the water produced for the city was 35%. The utility company's plan shows after ten years (i.e. 2010) the proportion of the unaccounted for water is planned to be reduced to 25% with a reduction of the loose by at lest 1% every year

WSI 04: Percentage of Urban and Rural Sanitation Coverage based on selected facilities.

TYPE OF SERVICE	ANATIONAL %	URBAN %	RURAL %
Flush toilet	1.7	7	0.8
Pit latrine	16.3	64.6	8.1
Container	0.1	0.7	0.0

WSI 05: Poverty Head count Indices (1995/96 and 1999/2000)

	1995/96	1999/2000	% Change over 1995/96
Urban	33.3%	37.0%	-4.2
Rural	47.0%	45.0%	11.0
National	45.5%	42.2%	-2.9

WSI 06: Number of areas or Location designated as flood prone area

There are five main localities that are designated as flood prone areas in the country.

1) Areas form Imi to Mustahile in the Wabe Sheble River Basin of the Somali Regional State;
2) In the South West of Ethiopia from the town of Gambella to the border town of Jikao in the Gambella Regional state in the Baro Akobo River basin
3) In the Afar regional state caused by Awash River
4) In the Amhara Regional State east of the lake Tana where Ribb and Gumara Rivers enter lake Tana
5) In Oromia regional state in the localities known as Tefki and Teji depression

WSI 07: Number of People affected by Drought

Year	POPULATION AFFECTED BY DROUGT	% OF TOTAL POPUALTION
1990	3429900	7.14%
1991	1850000	3.74%
1992	5228530	10.28%
1993	1644040	3.14%
1994	889000	1.66%
1995	3994000	7.25%
1996	3153000	5.56%
1997	1932000	3.31%
1998	5820415	9.69%
1999	2157080	3.49%
2000	7732335	12.14%
2001	6242300	9.53%
2002	5181700	7.7%
2003	14490318	20.94%
2004	9369702	13.17%

WSI 08: Tth Proportion of People considered migrants and non- migrants in urban centers of Ethiopia except for two regions (1994 census)

SEX	URBAN PERSONS	NONMIGRANTS	MIGRANTS	NOT STATE	AREA OF PREVIOS RESIDENCE		
					Urban	Rural	Not state
Male	3,231,593	1,773,640	1,436,910	21043	632698	801433	2779
Female	3,535,475	1,925,885	1,588,780	20,810	672450	913249	3081
Total	6,767,068	3,699,525	3,025,690	41,853	1,308,148	1,7114682	5860
Proportion of the total	100%	54.7%	44.7%	0.6%	19.3%	25.3%	0.1%

WSI 09: The Proportion of People considered as migrants and non-migrants in Rural Areas of Ethiopia (1994 Census)

Sex	All Rural Persons	Migrant Rural People	Non-migrants Rural People	Not stated	Areas of Previous residence		
					Urban	Rural	Not stated
Male	21,161,077	1,757,513	19,326,851	76,713	293,444	1,462,029	2,040
Female	20,971,126	2,133,450	18,764,131	73,545	213,951	1,917,369	2,130
Proportion of the total Rural People	100%	9.2%	90.4%	0.4%	1.2%	8.0%	0.0%

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Chapter 7

7. Water for Food

7.1 Surface Area of Total Cultivated Area

Ethiopia's total land area is estimated at 1.13Million km2. Out of this about 66 % is considered as arable land. Out of this total arable land 27.9 Million hectares or 22.8% of the total land area is already cultivated. 10.3% (12596900 ha) and 12.5% (15287500 ha) is intensively and moderately cultivated respectively.

7.1.1 Percentage of Irrigated Land

In the Ethiopian context, the irrigation sub-sector is classified as small (less than 200ha), medium (200 to 300ha) and large-scale (over 3000ha) schemes. Currently government emphasis is to develop the sub-sector to fully tap its potential by assisting and supporting farmers to improve irrigation management practices and the promotion of modern irrigation systems. Ethiopia's irrigation potential has been estimated to be in the order of 3.5 million hectares. The total area currently irrigated by modern irrigation schemes in Ethiopia is approximately in the order of 160000ha. In addition there are traditional schemes in the order of 120000 ha of traditional schemes in the Amhara, Southern Nations and Nationalities, and Oromia regions. There is no data on the extent of traditional schemes in the other regions of the country. The current level of irrigation development is much lower than 50% of the over 600,000 ha of irrigable land that should have been developed to meet the food demand of the present population in addition to what is being cultivated under rain fed agriculture.

Small-scale schemes grow cereals as main crops. Medium and large schemes grow sugar cane, cotton, and fruits. Currently, irrigated agriculture produces less than 3% of the total cereal production. Ethiopia's experience in large-scale irrigation development and management is in state enterprises, mainly growing industrial crops like cotton and sugar cane. The experience in small-scale irrigation development and management started in the 1970s by the Ministry of Agriculture, in response to major droughts, which caused wide spread crop failures and consequent starvation. Up until 1991 the Ministry of Agriculture had studied, designed and implemented more than 50 small schemes in the country, including the ADF funded schemes in the Amhara region. With the change of government in 1991, and devolution of power to the regions, small scale schemes have been implemented through the regional offices.

7.1.1.1 Water Used for Irrigation

Major crops

The major crops found in the country are those listed in paragraph 7.1.2.1 of this chapter. Crops under irrigation management in some parts of the country are listed in the same table. Other crops under irrigated management are also listed in tables 7.2 and 7.3.

Typical yield of irrigated agriculture

Tables 7.1 & 7.2 summarize the current experience of schemes in Amhara and Oromia regions particularly on small scale peasant holdings. Table 7.3 shows yields of some industrial crops grown in the Awash valley. Awash Valley was selected here as a representative of large scale estate farms.

Table7.1: Irrigated Crops Yields in Some Schemes in Amhara Region

SCHEME	CEREAL CROPS			VEGETABLES		
	LOW	HIGH	AVERAGE	LOW	HIGH	AVERAGE
KILTI	0.9	1	0.95	1	8	4.5
ZINGINI	2	2.2	2.1	2	7.2	4.6
FETAM	2.3	2.5	2.4	15	20	17.5
GERAY	1	6	3.5	1.5	8	4.75
JEDEB	0.8	1.9	1.35	4	6	5
AZUARI	0.9	1.2	1.05	5.5	12	8.75
M/GENET	1.1	1.6	1.35	4	5	4.5
WOLEH	0.8	1	0.9	4	10	7
SEWIR	1	3	2			
BETEHO						
ALAWUHA	1.5	2.1	1.3	1.3	1.5	1.4
DANA	0.9	1.8	1.35	1	8	4.5
SEWAK	0.9	1.6	1.25	5	8	6.5

Source: World Bank, Food Security , 2002

Table 7.2: Irrigated Crops Yields in Ormia Region

	Oromia Region Yield Assessment of Irrigated Crops	
Crops	**Yield Range Qt/ha**	**Average Yield Qt/ha**
Cereals		
Maize	9-35	21
Barley	8-20	14
Vegetables		
Tomato	75-232	129
Ethiopian Cabbage	42-146	97
Head Cabbage	149	149
Root Crops		
Irish Potato	72-138	106
Sweet Potato	10-256	101
Onion	32-109	75
Garlic	40-73	59
Carrot	40-120	89
Beetroot	60-140	107
Pulses		
Haricot Bean	4-16	8
Fruits		
Papaya	39-107	74
Banana	106-180	142
Orange	35-40	38
Other		
Coffee	1-4	3
Chat	33-65	50

Source: World Bank, Food Security, 2002

Table7.3: Irrigated Crops in Some Estates in the Awash Valley

Crop	State Farms			Other Farms		
	Upper Awash	Middle Awash	Lower Awash	Upper Awash	Middle Awash	Lower Awash
Perennial Crops:						
Banana	160	120	30	140	100	*
Citrus (Orange)	250	200	150	200	150	100
Grape	60	50	40		*	*
Guava	40	35	30	35	30	25
Sugarcane (Sucrose)	122	116	80	104	99	68
Winter Crops:						
Haricot bean-green	30	20	*	25	15	*
Haricot bean-seed	8	5	*	6	4	*
Melon	100	80	60	75	60	45
Okra	50	50	40	40	40	30
Onion	120	100	*	100	80	*
Tomato	250	200	150	200	150	100
Sorghum (grain)	30	30	30	25	25	25
Maize	25	20	15	25	20	15
Tobacco (cured leaf)	12	10	*		*	*
Wheat	20	18	15	20	18	15
Summer crops:						
Cotton	24	34	22	20	20	15
Groundnut	12	10	*	10	8	*
Kenaf	20	20	15	15	15	10
Maize	25	15	*	25	15	*
Rice	20	30	35	15	20	25
Tobacco (cured leaf)	10	*	*		*	*
Tomato	200	150	*	150	100	*

Source: Awash Master Plan, 1989

Water use efficiency and potential for improvements

The effectiveness of water use and benefits in terms of crop yield are determined to a large extent by when the farmer irrigates how much water is applied and how it is applied. Water applied to a field during irrigation is primarily for storage in the root zone and subsequent consumptive use by a crop. Other beneficial use of water may include application to a field to permit tillage, to provide water for germination, for temperature control and to reduce surface or soil salinity. Farmer application efficiencies are not generally high in Ethiopia as in many other countries in the world. Some of the factors which contribute to ineffective use of water in Ethiopia are lack of water measurement and control of amount of water applied in relation to soil moisture holding characteristics and crop requirement, inadequately leveled and improperly designed fields, infiltration rates that cause excessive applications when water use rates are low and under irrigation when water use rates are high and the inability to adjust frequency of irrigation to crop water requirements due to the fixed supply of water.

An indicative assessment of irrigation efficiencies for some farms in the Awash basin was carried out during the Awash Master Plan study. The results of this assessment indicated the overall efficiencies ranged from 30 to 50% as indicated in Table 7.4.

Table 7.4: Indicative Irrigation Efficiencies for Major Farms in Awash Basin

Farm	Estimated overall Efficiency %
Wonji/shoa	50
Nura Era Complex	30
Metahara and Abadir	50-55
Amibara Irrigation Project III	50
Angelele Pump Scheme	35-40
Gewane	35
Dubti, Dit Bahir State Farm	35-40
Assaita Relief & Rehabilitation	30
Small Settlement Farms	30-35

Source: Awash Basin Master Plan Study

These figures are indicative of the overall situation and show that water use efficiencies are low for most of the farms. In fact individual results of as low as 17% have been encountered. Improvement of on-farm water management has a great potential for increasing the effective irrigation water supply.

Utilization of groundwater

In Ethiopia use of groundwater is limited to water supply only. Use of groundwater for irrigation has never been given consideration due to availability of surface water in sufficient quantity and its under utilization. There is only one scheme in the Raya Valley in Tigray Administrative Region where ground water is used for irrigation.

7.1.2 Percentage of Rain-Fed Land

The estimated 27.9 million hectares cultivated land represents the rainfed agriculture in the country. Most of Ethiopia's agricultural land is classified as Weyna Dega, mid-highland areas with altitude of 1500 to 2300 meters. It is characterized by temeperatures ranging from 16 to 29° C and rainfall varying from 300 to 1400 mm. Some areas receive as much as 1400 mm and are sometimes referred to as wet Weyna Dega. Other areas receive 900 to 1400 mm of rain and are known as moist Weyna Dega. Most of the country's food crops such as teff (a staple food in Ethiopia), maize, wheat, and pulses as well as coffee are grown in this wet and moist mid-highland zone. The main surplus grain producing zones of the country, including most parts of Shoa, Arssi, Gojjam, and some parts of Gondar, as well as coffee growing areas such as Sidama in SNNRP, the former Kaffa administrative zone, Wollega and Illubabor are classified as Weyna Dega. The production of enset, staple food crop in the Southern Region, is also concentrated in this agroclimatic zone. Two growing periods (under rainfed conditions) per year are possible in some of the rainy areas. Nonetheless, extensive land use has resulted in high degree of erosion and sharply reduced forest and grass cover. The annual rainfall in the drier part of weyna dega is 300 to 900 mm and the main crop is Sorghum. Other crops such as wheat and oilseeds are also grown. A good part of the regions of Tigray, Gondar, and Wollo are known to have dry weyna dega climate. Drought and severe degradation have become major constraints to production and most of the relief assistance in the country is directed to these areas in recent years.

Lowland areas, which are classified as kola, are located between 500 and 1500 meters. The temperature is hot, over 27° C, and the weather is dry with less than 450 mm of rainfall. The growing period is very short and can only support a few drought-resistant crops such as special

varieties of sorghum. These areas are populated mainly by semi-pastoralists. Lowlands, which lie below 500 meters, are known as berha or desert. These areas are sparsely populated with nomadic herders. Crop production can only be carried out through irrigation mainly from rivers flowing out of the highland areas. Kolla and Bereha areas are chiefly concentrated in the Afar and Somali regions and the Borena zone of Oromia region.

7.1.2.1 Major Crops And Typical Yield

Crop Types

The following Table 7.5 summarizes the major crops found in the country together with the different parameters for their adaptability.

Table7.5: Crops and their climatic requirements in Ethiopia

Crops	Altitude	below 1500m			1500-2100m			2100-2700m				
	Growing Period	SA	H	PH	SA	H	PH	SA	H	PH	H	PH
Barley											XX	X
Oats								X	XX		XX	X
Bread wheat		I			X	X		X	XX		X	
Durum wheat					XX	XX		X	X			
Teff		X	X		XX	X		XX	XX			
Maize		XI	XX		X	XX			X			
Sorghum		XI	XX		XX	XX	X	X	X			
Finger millet		XX	XX		X	XX						
Rice		I	XX	X		X	X					
Horse bean					X	XX		X	XX		XX	
Field pea					X	XX		X	XX		XX	
Lentil					XX	X		XX	X		X	
Chick pea		I			XX	X						
Grass pea			X			XX			X			
Lima bean						XX	X					
Haricot bean		XI	X		XX	X						
Cow pea		XI	XX		XX	XX						
Linseed						X			XX		X	
Safflower		X	X		X	XX			X			
Rape seed						X			XX		X	
Niger seed					XX	XX		X	X			
Sunflower		XI	XX		X	XX		X	X			
Sesame		XX	X									
Groundnut		XI	XX									
Soya bean						XX						
White potato					X	XX		X	XX		XX	
Sugar beet									XX	X	XX	X
Enset						XX	XX		X	XX	X	X
Paro			XX	XX		XX	XX					
Sweet potato		X	XX	XX	X	XX	XX					
Cassava		X	XX	XX	X	X	X					

Table Cont'd

Cotton		XI	XX		X	X					
Sisal			XX	X		X	X				
Kenaf		XI	XX		X	X					
Citrus*		I	X			X			X		
Grape		I	X			XX					
Banana		I	X	XX		X	XX				
Coffee			X	X		XX	XX				
Tea				X			XX				
Tobacco		I	XX			X					
Pyrethum									X		X	XX
Chillie pepper		X	XX		XX	XX		XX	XX		XX	X
Sugar cane		I	X	XX		X	XX				

Source: Master Landuseplan, FAO-UNDP, 1984

SA: Semi-arid conditions with a growing period between 75 and 120 days

H: Humid conditions, with a growing period between 120 and 240 days.

FH:Perihumid conditions, with a growing perod of more than 240 days

X: Crop grown under rainfed conditions

XX:Most suitable growing conditions with respect to altitude and growing period

I: Crop grown under fully irrigated conditions

**: Suitability for citrus depends on the type grown*

Crop Yields

Crop yields vary considerably according to management practice, the annual soil fertility, the genetic production potential of seeds and the efficiency of extension services, etc. Average crop yields at national level according to CSA are shown in Table 7.6. The table gives three types of yield levels for:

- An average harvest, Meher (main harvest season) season 1999/2000
- A bumper harvest, meher season 1996/97
- A very poor harvest due to shortage and untimely rainfall, Belg(small rain season) season 1999

Table 7.6: Estimated yields of Major crops for peasant holdings at national level.

Crop Type	1999/2000 Yield (QT/HA)	1996/97 Yield (QT/HA)	1999 Yield (QT/HA)
Cereals	11.47	12.90	6.15
Teff	8.09	9.23	3.16
Barely	9.34	10.64	7.18
Wheat	11.83	12.97	6.17
Maize	17.95	19.23	6.34
Sorghum	11.87	14.34	4.41
Millet	8.87	10.19	7.55
Oats	10.33	11.05	4.27
Pulses	9.18	8.87	2.74
Horse Beans	10.82	9.74	2.02
Field Peas	7.62	6.72	2.20
Haricot Beans	8.00	8.40	2.71
Chick Peas	8.91	8.55	**
Lentils	6.89	6.53	**
Vetch	9.72	11.49	**
Others	4.49	4.46	2.09
Neug	3.98	3.33	**
Linseed	4.34	4.56	**
Rapeseed	6.82	**	-
Ground Nuts	8.80	7.19	-
Sunflower	7.10	**	-
Sesame	4.09	3.93	-
Fenugreek	6.64	5.81	**

Source: World Bank, Food Security, 2002

7.2 Water Use of Livestock, Fisheries and Aquaculture

Fisheries and Aqua Culture

Ethiopia has nine major rivers and tributaries, (Abay, Awash, Omo, ghibe, Genale-Dawa, Wabi Shebele, Baro-Akobo, Tekeze-Angereb, Mereb), if harnessed for irrigation and hydropower that could be used for fish production. In addition, the Rift Valley Lakes and others and the existing reservoirs (Aba Samuel, Koka, Fincha and Melka Wakena) have a large potential for fishery development.

A study by FAO (1986) defined the fish farming zones and species suitable for the zones based on water temperature , local climatic conditions and water quality.

Accordingly, the hot lowlands are found to be suitable for warm water species like telapia, clarias, and prawns. The highland perimeter and central highlands are suitable for cold water fish such as trout.

However, it has been concluded that other species could also be developed selectively on the basis of detailed studies on cost benefits, biotechnology and utility criteria as there are over 100 species of fish reported to be found in Ethiopia. EVDSA/WAPCOS study estimates the fish yield of the various inland water bodies to be 38162 tons. It is also believed that future reservoirs could be used as important sources of fish production.

Water and Livestock

Ethiopia has an estimated livestock population of about 35 million TLU. Assuming an average consumption of 25 liters of water/day per TLU (TLU=Tropical livestock unit is equivalent to an animal of 250 kg live weight on maintenance), the estimated daily water consumption is about 875 million liters. This adds up to about 320 billion liters per annum. This requirement is expected to increase due to the increase in livestock population and envisaged improvement in productivity. Improvement in the dairy sector , for example, will require additional water for milk production and sanitary management.

7.3 Goals and Programs

7.3.1 Per Capita Food Consumption

It is obvious that the country is not food self-sufficient. The people are not getting sufficient food. Food consumption varies from region to region, families sources of primary income, the large majority is consuming less than what is required for normal body functioning i.e. 2100 kcal. The nutrition survey conducted by CSA, a significant number of children are undernourished.

For the year 1992/93 the FAO/WFP crop and food supply assessment mission to Ethiopia used the established per capita annual consumption rate of 135 kg of cereals, 22 kg cereal equivalent Enset (false banana), root crops, milk and meat and an additional 6 kg of cereal equivalent oil seeds, eggs, fish as well as meat. This is on the average a total of 163 Kg of cereal equivalent per person per year. On the basis of calories content of various food categories established by Ethiopian nutrition Institute, the 163 kg of cereal equivalent food represent a daily calories intake of 1518 kcal per person per day. The national programme for food production, food security and nutrition covering the period 1993/94 –1997/98 has placed the attainment of increased food intake per person as an indicator of agricultural development.

The food requirements assuming 2100 kcal per person per day, which is assumed to be equivalent to 225 kg of grain per person per year is presented here under.

Table 7.7: Annual grain requirements Estimates

Year	Total Population	Requirement in Qt. (225 kg of grain/person per year)
1990	48,051,000	108,114,750
1991	49,444,479	111,250,078
1992	50,878,369	114,476,330
1993	52,353,842	117,796,145
1994	53,477,265	120,323,846
1995	55,056,784	123,877,764
1996	56,684,494	127,540,112
1997	58,361,928	131,314,337
1998	60,090,666	135,204,000
1999	61,872,347	139,212,780
2000	63,708,658	143,344,481

Table Cont'd

2001	65,490,215	147,352,983
2002	67,323,472	151,477,811
2003	69,210,000	155,722,499
2004	71,151,420	160,090,696
2005	73,149,407	164,586,166
2006	75,065,505	168,897,386
2007	77,034,632	173,327,923
2008	79,058,361	177,881,312
2009	81,138,312	182,561,202
2010	83,276,158	187,371,356
2011	85,309,887	191,947,245
2012	87,396,780	196,642,755
2013	89,538,347	201,461,281
2014	91,736,145	206,406,326
2015	93,991,777	211,481,497

Source: extracted from Population and Housing census, 1994 and different sources

7.3.2 Major Programs in Progress and Future Plans

Small scale and water harvesting schemes

The short, medium and long-term development targets of small scale irrigation development covering the planning years 2002-2016 is 40319 ha, 40348 ha, and 46471ha respectively in the eleven regions of the country. There are 6174 ha of small scale irrigation schemes currently under construction in Amhara, Tigray, Oromia, and Southern Nations and Nationalities with financial support from IFAD and AFD.

According to the Food Security Strategy Document of the country in the coming 3 – 5 years 5 million people would be made food-secure and an additional 10 million people improve their food security status through water centered development as a key strategy. Rain water harvesting has been adopted as appropriate technology. For crop production RWH has two purposes: first to raise vegetable as well as fruit seedlings during the dry period and carry it to rains when they set in, second to provide water as supplementary irrigation whenever there is a shortfall in wet seasons, especially at the time of maturity.

Different kinds of water harvesting technologies have been implemented since 2002 in the four main regions of the country. Recent assessments revealed that: 308,338 Shallow wells (hand dug wells) have been constructed, 205,787 household and 49,311 community ponds have been dug, 5,632 cisterns have been constructed, and 32,727 springs have been developed. It estimated that a total of around 93,326 ha of land can be irrigated using these schemes and 732,336 households with 3.7million members would gradually benefit assuming 5 members per household. Along with the storage facilities low cost water lifting and family drip equipments/systems have been and are being promoted.

In the next fiscal year 2004/05 it expected that double the amount of schemes will be implemented to reach the target beneficiaries in the country.

Large and medium scale irrigation

The sector development program identified 146691 ha of land to be developed as medium and large scale schemes in the short, medium, and long term during the program period (2002-2016). However, this figure was based on very low level of development every year and did not represent the actual need to meet the incremental food, fibre, and sugar demand during the program period, which was estimated at 1.8 million hectares as the level of irrigation development required to meet the demand of the projected population of 96.34 Million people. Recently the level of development has been revised and an intermediate level of 358695.ha is now the proposed target level for medium and large scale irrigation development up to the end of the planning year-2016. Only one large scheme of 6000ha is currently under construction in Koga area of Amhara region.

7.3.2.1 Progress Towards MDG Goals

Millennium development targets for irrigation are those included in the sector development program, which is reproduced in Chapter 2 of this document. The targets reflected only what is believed to be within the implementation capacity of the country. Now that level is to be revised as it underestimate what is actually needed to be the MDG target. An accelerated program is currently being proposed by the Ministry of Water Resources , which sets the target for 2016 as 358695 ha . This level is also much lower than what is actually required but much better than what is included in the Sector Development Program. It is believed that with current shift in direction to develop more and more irrigation, the accelerated development could change to another higher level.

Water harvesting was not considered in the sector development program as one option of irrigation development . But with the introduction of the Governments food security program it has been given more emphasis as better technology option to be adopted by farmers. Implementation of water harvesting schemes started in 2002 and it is being implemented aggressively throughout the country.

In the following two tables targets and achievements of large and medium schemes(accelerated program), small scale irrigation, and water harvesting schemes are summarized.

Table 7.8: Target Implementation of Irrigation up to 2016

Type of scheme	Target Implementation of Irrigation Development to Meet MDG(ha)															
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
1.large and medium scale irrigation						6,086	11,238	27,579	43,400	46,650	48,040	44,147	39,701	34,858	30183	26813
2.small scale irrigation			40319					40348					46471			
3.water harvesting schemes																

Table 7.9: Achievement of Irrigation development since 2002

Type of scheme	Irrigation Developed to Meet MDG															
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
1.large and medium scale irrigation(ha)	-	-	-	-	-											
2.small scale irrigation(ha)																
3.water harvesting schemes(No)			601,795													

7.3.3 Agricultural Policies

Ethiopia has diverse physical features with variety of climatic conditions. Some 66 % of the country is potentially suitable for agriculture. The high rate of population growth is a serious threat to food security unless offset by a substantially higher growth in food out put. Population explosion and food insecurity are serious twin problems that must be addressed simultaneously on priority basis.

Small farmers in Ethiopia are caught in a vicious circle of low level of income, low investment in improved technology, low level of agricultural productivity and lack of access to institutional marketing and credit. The situations among the Pastoralist are worse.

Despite several attempts to redress the situation, the problem of environmental degradation, agricultural productivity and food shortage remains critical and threatens to worsen in the face of rapidly growing population.

This dire situation resulted in the need to substantially raise agricultural production and productivity so as to enable agriculture to provide food security for the country and play its newly assigned role in "Agricultural Development Led Industrialization" of the nation's economy.

With this in mind, the agricultural development programme aimed at promoting sustainable management of natural resources and increasing agricultural production, fishery and insuring food security and nutrition of the population is formulated with the following main objectives:

- Increase the production of food supply both quantitatively and qualitatively so that members of the sector will be adequately fed, while the population in the other sectors will also be supplied with adequate food at affordable prices.
- Improve the quality of life of the rural population through the generation of higher incomes and reduction of poverty, promoting higher standards of nutrition and health, greater equity progress in education and personal freedom.
- Increase and diversify the production of raw materials for industry and promote strong linkage with the industry sector.
- Increase and diversify the production for export and maximize the country's foreign exchange earnings from agriculture.
- Make agriculture the driving force for economic development a dynamic growth in agricultural production with raised income, which will be followed by increasing demand for products and services from the other sectors of the economy.

7.3.4 Social Aspects

7.3.4.1 The Role of Irrigation in Alleviating Poverty and Improving Food Security

Agriculture in Ethiopia heavily depends on rainfall where the pattern is of erratic and unpredictable nature. For most small holder farming and pastoral system, rainfall is the major source of moisture for crop and livestock production. However, the frequency of drought has sharply increased its occurrence, i.e. every three to five years. Moreover, utilization of water

resources is ill developed. Irrigation and water diversion schemes are less practiced, hence, food production has seriously been affected.

Climate change, in combination with other factors, has resulted in serious and growing problems of food security. The extent of food insecurity in Ethiopia in recent years has become alarming and its coverage in drought periods has reached as high as 45 percent of the population.

Since the country is dependent on agriculture, crop failure usually leads to household food deficit. The absence of off-farm income opportunities, and delayed food aid assistance, leads to asset depletion and increasing levels of destitution at household level. Over the last fifteen years this situation has resulted in importing of 700-thousand metric tons of food aid per annum to meet food needs.

To mitigate the food insecurity problem of the country the government embarked on implementation of food security program in 2002. The development objective of the food security project are to build the resource base of poorer rural households, increase their employment and incomes, reduce their real costs of food, and improve nutrition levels for their children under five years of age, and pregnant and lactating mothers. The project has four windows of finance one of which is funds to communities of which one of the objectives is to invest in small scale irrigation.

7.4 Indicators

Indicators for the chapter are summarized in table 7.10 below:

Table 7.10: Indicators

Indicator	2002….2015
• Total arable land • Arable land as percent of total • Total Cultivated as percent of arable land • Potential irrigable land • Potential irrigable land as percent of arable • Total irrigated as percent of potential irrigable • Total irrigated as percent of cultivated land • Irrigated production as percentage of agricultural production • Percent of undernourished people • Percentage of people below the poverty line • Percent of poor people living in rural areas • Relative importance of agriculture in the country's economy • Relative importance of agricultural water use in the water balance • Water production in agriculture • Importance of aquaculture and inland fisheries	

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Chapter 8

8. Water and Industry

8.1. Introduction

The establishment of modern manufacturing in Ethiopia started towards the end of the 19th century. A number of factors contributed towards its development out of which the installation of the Ethio-Djibouti railways and the increasing influx of foreign citizens from Armenia, Greece, Italy and India are cited as the principal ones. The emergence and expansion of manufacturing enterprises in Ethiopia was based on meeting available demand for consumer goods and building construction materials.

Regarding the Regional distribution of manufacturing establishments, most of the industries are located in Addis Ababa, Oromiya, SNNP and Amhara Regions. Addis Ababa Region alone accounts for more than 65% of the total number.

Table 8.1: Regional Distribution of Manufacturing Industries

Region	Major products	Gross value of production (000 Birr)	Number of industrial facilities	Number of persons engaged
	Textiles, Medicine, Marble, Food	78,193	21	1,889
Afar	cotton milling, Non-metallic mineral products	67,736	3	285
Amhara	Food, Beverage, Textiles, Non-metallic mineral products	261,125	44	8107
Oromia	Leather, Cement, Food, Marble, Beverage, Furniture and wood products, chemicals	1,894,373	101,	15,992
SNNP	Textiles, Ceramics, Food, Furniture and wood products	187,833	57	5,454
Gambella and Somali	Wood products, Non-metallic mineral products	3,850	4	132
Harari	Food printing, Non-metallic mineral products	91,766	6	1,000
Addis Ababa	Leather, textiles, Food, beverage, Printing, Metal products, machinery and equipment, chemicals	3,233,762	484	54,284
Dire Dawa	Textile, Cement, Food and Beverage	177,561	21	6,023
Total		5,996,199	741	93,166

8.2 Impact of Industry on Degradation of Water Quality

A number of pollution related studies have confirmed that about 90% of industries in Addis Ababa are simply discharging their effluent into nearby water bodies, streams and open land without any form of treatment. In the 1992 to 1994 wastewater facilities master plan project study, it was reported that out of 70 factories, 56 (80%) were dumping their untreated effluent into nearby watercourses and urban streams. In 1997 Environmental protection Agency conducted a survey on the kinds of waste generated by industries and the number of factories with treatment plant. As it can be seen on table 8.2 out of the 40 industries that responded to the questionnaire only 3 (about 8%) of them have any form of treatment plant.

Table 8.2: Numbers of factories with treatment plants

Factory sub-sector	No. of factories		No. of factories with pollution of water			With TP
	Reached	Replied	Air	Land	Water	
Tanneries & leather products	9	6		5	5	
Chemicals	10	7	1	5	7	1
Textile	9	7	2	4	7	1
Metal	8	7	2	4	7	
Non-Metal	2	2	2			
Beverage	7	4	1	1	4	
Food	5	4	1	2	3	
Abattoir	1	1	1	1	1	
Hospital	2	1		1	1	1
Sewerage treatment plant	1	1		1		1
Total	54	40	10	33	23	3

The hazard presented by industrial and domestic pollution of the Awash River and especially its tributaries in the upper reaches, were identified in a study of water pollution in the Upper Basin in 1974. The report presents data from 22 stream sites within and 11 outside Addis Ababa, reflecting the quality of water before and after passage through the urbanized area. The results indicated that, upstream of Addis Ababa, the streams monitored showed only slight evidence of pollution, mostly domestic in origin. Once the steams entered urban Addis Ababa, a dramatic and rapid deterioration is apparent, rapidly reducing the quality of all streams and rivers to worse than that of typical raw domestic sewage with evidence of gross industrial and domestic pollution. Oxygen within the streams was virtually depleted, resulting in septicity and anaerobic decay.

8.2.1 Pollution Loads of Industrial Effluents

Most of the high water consuming industries in the Awash basin in particular in the city of Addis Ababa and in the Akaki area draw water for production purposes from water supply sources and discharge their by-product wastes in to streams and rivers without any kind of treatment. Besides this, there is no restriction on industrial plants discharging their wastewater into the rivers and watercourses.

However, few industries in the city of Addis Ababa, which have treatment facilities, divert their raw wastewaters into the storm water drainage system or the watercourses. The reason could be either for technical reasons related to the wastewater treatment plant operation or for practical reasons since there are no regulations and effective control regarding industrial effluent discharges by concerned parties.

Some studies indicate that the industries equipped with some form of effluent treatment facilities have installations undersized and frequently inoperable. It seems that the main function of these facilities appeared to have been obtaining the permit required to build the factories. There are very few industries in the city of Addis Ababa that use septic tanks for the disposal of industrial waste effluent.

According to the 1996 report by Ministry of Health on the study of liquid waste management, out of 118 industrial establishments assessed in the city of Addis Ababa, 40have solid waste discharges, 61 generate air pollutant discharges while 62 generate liquid wastes that are discharged to the surrounding. Only 6 out of the investigated factories are found to have some form of wastewater treatment plants while the rest discharge their wastes with out any form of treatment.

There are a number of industries in the Rift Valley Lakes basin mainly in Awassa and Arba Minch, which produce large quantity of wastewater, and disposing them into nearby water bodies. The textile and ceramic factories in Awasa town dispose their wastes to the adjacent areas, which ultimately pollute the surface water and ground water sources. Almost all industries do not have wastewater treatment plant and wastewater quality data. However, it has been learnt that few physical, COD, BOD and pH data for Awassa textile factory are available in the Regional Health Bureau. Under the present circumstance there is no restriction on industrial plants discharging their wastewater into the rivers and watercourses.

In some areas untreated wastes from coffee pilling and washing industries are discharged in to streams and rivers and there is a growing concern that it will become a potential pollution risk in the region. The textile industry in Arba Minch is situated by the side of lake Abaya and its wastes could affect the near by water body and surroundings as there are no regulations and effective control regarding industrial effluent discharges by concerned parties.

Soda ash factory in Zeway is also believed to be a major treat in creating pollution to the near by water body i.e. lake Zeway and the surrounding.

The hazard resulted from municipal and domestic pollution of the Awash River and in particular its tributaries in the upper reaches were identified by studies conducted in the past (a study of water pollution in the upper basin in 1974). Up-stream of Addis Ababa, the streams monitored showed only slight evidence of pollution, mostly domestic in origin. As the streams entered the city of Addis Ababa, a dramatic and rapid transformation is apparent, abruptly reducing the quality of water in all the streams and rivers.

Under dry weather condition, the discharges in all the streams draining Addis Ababa are effluent based. Surface waters and drainage systems in Addis Ababa serve as open sewers. The drainage systems which were meant to collect run-off water (Storm-water) are also being used for disposal of almost all categories of wastes (domestic, industrial, commercial, private and public) including solid wastes and grit that are major causes for the frequent blockage and overflow of waters on to streets and surroundings.

The difficulty of towns situated within Awash river basin such Debre Zeit, Mojo, Nazeret, Kombolcha, Dessie and others is not different from that of Addis Ababa except that the scale of industrial development is very low and water bodies around these towns are mostly polluted by septic tank and pit latrine overflows as well as waste waters from various institutions and domestic sources.

People residing in the rural area defecate openly on land or at the banks of water bodies, which will find its way into natural watercourses. Consequently, both surface and ground waters in these areas will be subjected to faecal pollution leading to prevalence of a wide variety of water borne diseases.

The major problems in the rural settings are the absence of at least dry pit latrines, the washing of clothes and taking of baths right in the river water, and the wide spread littering of animal dung which in one way or the other contribute to contamination of the water supply sources

The assessment on existing situation of solid waste management in the country shows that the services are inadequate and the coverage is very low. The problem of solid waste management is critical in densely populated urban centres. Domestic solid wastes are dumped at the riverbanks, roadsides, ditches, drainage pipes and pit latrines.

A very small proportion of wastes generated in some urban centres such as Addis Ababa, Nazereth/Adama, etc are collected by litter trucks and dumped at the outskirts of the cities and towns. The number of communal solid waste collection bins are very few and scattered in comparison to the solid waste generated in Addis Ababa.

The small to large sized public and private hotels in the city of Addis Ababa and elsewhere discharge their wastewaters into watercourses and storm drains with out any treatment.

Wastewaters generated by hospitals and clinics, which are similar to domestic effluent have no facilities for either treatment or pre-treatment before discharge. While very few may be connected to the wastewater collection system, others use septic thanks for sewage disposal and the raw sewage produced by many hospitals are discharged directly into nearby rivers and watercourses.

The danger of faecal pollution is more serious in Ethiopia because majority of the population do not have access to safe drinking water. For instance, cases of typhoid in Addis Ababa have increased as a result of sub-surface leaching of septic tank effluents and due to leakage problems. The health of the rural population is also threatened by pollution of unprotected springs; hand dug wells, ponds and streams by cattle dung and human excreta. Water bone diseases and other diseases transmitted by vectors that bread in water are the most rampant in the country.

Municipal wastes, industrial wastes and poor irrigation practices account for the major causes of ground water pollution in the Awash basin. Dumping of raw sewage directly into the rivers and permeable aquifers is common in the urban areas. As a result, high nitrate concentrations are observed in the ground waters of urban areas like Addis Ababa and others.

The 1992 survey made on 45 wells in the city of Addis Ababa demonstrates that 19 wells were polluted with nitrate concentrations as high as up to 75 ppm, which is well above the limit (45

ppm) for drinking waters. High nitrate concentrations were also noted in the hand dug well waters in the rural settings and small towns.

The high nitrate concentrations of Addis Ababa are associated with densely populated areas with poor excreta handling and disposal system. Although there is lack of study and accurate data on the overall situation of ground water and on the sources of pollution as a whole, it can be assumed that similar situation would exist in the rest of the towns located in the basin.

All the towns situated in the Rift valley lakes basin do not have appropriate wastewater collection and treatment systems. In the majority of the cases wastewater is directly discharged in to open water bodies and adjacent areas. During dry period when the flow of a stream assumes absolute minimum the quality of the water could be examined to understand the situation at the ground.

Data on domestic wastewater quality and on receiving water bodies are not available. Water quality data are also lacking.

In most of the cases where streams and rivers are situated near by the towns, the most likely sources of pollution are from septic tank and pit latrine overflows as well as waste waters from various institutions and domestic sources.

The disposal of wastes generated in the urban centers is not yet practiced such as collecting by litter trucks and dumping at the outskirts of the towns. Communal solid waste collection bins are not in almost all the towns available.

The high nitrates concentrations in some areas in particular in traditional and hand dug wells and also shallow wells are associated with poor excreta handling and disposal system and the presence of large animal population which leave behind their dung around the water sources. Hand dug wells in Meki areas were found to have high nitrate, which were probably caused by pollution from nearby toilet pits. Lack of study and accurate data on the overall situation of ground water and on the sources of pollution as a whole, it can only be assumed that partly human and in some cases natural causes may exist.

With respect to the state of industrial effluents discharged from industries in and around Addis Ababa, the Environmental Protection Authority recently (1999/2000) undertaken analysis of waste water discharged from industries in and around Addis Ababa. The waste water analysis covered 33 industries with two samples taken on different days from each industry. The average of the result obtained for some of the parameters are indicated on table 8.3

Table 8.3: Pollutants from Industries

Name of the Factory	PH	SS	DS	BOD5	Nitrate	Sulfate	Chloride
Addis Soft Drinks	11.7	94	2880	581.5	Nil	40.65	Nil
Awash Winery	7.46	3249	2923	112,768	9	40.5	25
Metal Abo Brewery	5.27	429.5	211	12169.5	3.75	Nil	20
MOHA Soft Drinks	12.3	157.5	4393	407.5	13.5	277.5	32.5
National Alcohol and Liquor	7.91	2345	1383.5	13,550	0.2	2.5	4
St. George Brewery	6.64	36	62	55	1.05	5.95	5
Addis Gas and Plastic	8.27	13	9087.5	13.5	1.6	12.95	785.25
Addis Tyre	8.89	272.5	895.5	24.65	2.7	2646.25	675
Cora Gas & Chemical	10.1	27670	3720	85	Nil	8.86	16
Equatorial Paint	8.3	3616	41.5	575.5	Nil	312.5	52.5
Gullele soap	13.5	205.5	89650	57231.5	200	80	3.5
Nefas Silk Paint	6.58	3612.5	165.5	228.5	23.75	350	7.5
Repi Soap	9	321.5	1990	1034	7	25	52
Addis machine Tools	8.24	31.5	645.5	16.6	6.7	213	70
Akaki Spare Parts	6.74	262	411.5	11	7.65	25.95	57.5
Akaki Metal Products	2.75	93.5	3540	73	11	20.3	1220
Ethiopian Metal Foundry	7.51	40.5	292	13	11.12	24.2	12.5
Kaliti Metal Product	8.64	157	304.5	165	7	87.8	27.6
United Abilities	7.1	1.1	100.5	3.65	1.2	0.825	4
Addis Tannery	9.45	1350.5	4089.5	2428.5	113.75	1520	150
Awash Tannery	3.8	664.5	17425	914	6.25	1576.25	11500
Blue Nile Tannery	8.27	1365	180	1673.5	14.4	959.5	200
Dire Tannery	5.96	1615	1195	2782	375	3276.5	18750
Hafeda Tannery	7.73	709.5	13400	985.5	6.85	250.87	60
Walia Tannery	10.5	97	5250	1648	17.64	144.7	175
Akaki Textile	9.07	159.5	966	259.5	5	57.85	116.5
Edget Yam	10.3	54.5	251.5	81.5	5	29.8	9
Nefas Silk Thread	8.01	86	303	10	3.1	17.55	24

8.2.2 Pollution Load of Receiving Bodies

Similar industrial survey made in 1999 also shows that, almost about 80% of the factories in Addis Ababa are discharging their effluent into nearby water bodes without any form of treatment. Both in quantity and quality, industries are identified to be the first in causing severe pollution problems in Addis Ababa urban streams and in Lake Aba-Samuel. The following tables 8.3-6 indicate the pollution impact of industries on streams that are flowing through Addis Ababa.

Table 8.4: Pollution load on Small Akaki & Tributaries

Sampling Location	BOD5	DO	NH3	CL
Before Bulele Soap Factory	3.5	7	0.53	5
Addis -Jimma Road Bridge (Near Building College)	339	0.8	32.3	110
Addis -Jimma Road Bridge (Zenebe Work Area)	40	0.6	8.8	50
Fifth Police Station Bridge	535	0	63	83
Abattoir Aea	444	0	71	85
Near Behere Tsige Park	252	0	52.5	65
Down Stream of Kaliti waste water treatment plant	105	0	80.6	235

Table 8.5: Pollution load on Kebena, Kurtume and other Streams

Sampling Location	BOD5	DO	NH3	CL
Kurtume, Near Habte Georgis Bridge	93	0.6	51.6	63
Kurtume, Near Post Office	134	2	55.5	64
Near Zewditu Hospital	144	2	58.1	15
Near Kechene Bridge (Higher ground)	36	4.8	13.2	70
North of French Embassy (higher ground)	11	6..6	0.6	57
Misrak High School Area	63	3.7	38.7	45
Urael Bridge (Down stream side)	24	0.8	30.7	48
Bole Bridge	60	0.6	32.3	47

Table 8.6: Pollution load on Big Akaki River

Sampling Location	BOD5	DO	NH3	CL
Near Legedadi Dam	5	7.7	0.6	2
End of Bole Runway	32	1	21.3	35
Near Akaki Bridge	10	4.7	0.9	22

In all cases, within the urban areas of Addis Ababa, all beneficial uses of rivers and streams were precluded by their appalling quality. Since a very large number of people have no other source of water for domestic, agricultural or livestock watering purposes, it is not surprising to see both acute and chronic health effects in evidence as a result.

Some of the major diseases that are related to water can be categorized as follows.

Table 8.7: Categories of Diseases Related to Water

Category	Example
Water Borne	Typhoid, Cholera, Infectious Hepatitis
Water Washed	Scabies, Trachoma, Bacillary Dysentery
Water Based	Scistosomiasis, Guinea worm
Water Related Insect Vectors	Sleeping sickness, Yellow fever, Malaria

Although it was not possible to find specific data on the state of environmental health along the steams, most of the above diseases are causing significant threat to the communities that are dependent on these water bodies for their survival. In general one can make the following major conclusions based on the above review.

- The pollution that has been caused by the industrial waste water discharge has reached to level of major concern
- Almost all of the industries up on which a sample analysis has been done are discharging, effluents that contain pollutants well beyond the permissible internationally accepted standards.
- The studies conducted on the streams that are flowing through Addis Ababa have shown that most of these steams are currently dead due to the pollution load.
- Out of all the industry sectors, the Textiles and the Tanneries are making the major contribution of pollution loads on receiving water bodies.

8.2.3 Water Demand of Industry

Industries having high water consumption are often expected to have their own sources of supply. Heavy industries in the capital Addis Ababa meet their water demand requirement from ground water or/and share from the water supply system of the town. Table 8.8 shows the water consumption of main industries in Addis Ababa.

Table 8.8: Water Consumption by Main Industries in Addis Ababa Area.

No.	Name of Industry	Major products	Water consumption (m3/day)
1	Addis Ababa Tannery	Leather	350
2	Tikur Abay Shoe Factory	Shoes	275
3	Gulele Soap Factory	Soap	64
4	EthioMarble Industry	Polished Marble	16
5	Shegate State Garage Anbessa	Oil	20
6	Idgate Food Oil Factory		42
7	Research Institute Lab		135
8	Oil Factory	Oil	35
9	Edible Oil Factory	Oil	100
10	Oil Factory	Oil	25
11	Abay Soft Drinks Factory	Soft Drinks	360
12	Anbessa Flour	Flour Pasta	35
13	Addis Soft Drink Factory	Soft Drinks	345
14	Ethiopian Tyre & Rubber Factory	Heat, Strap Neolit	45
15	Awah Wine Factory	Wine	178
16	Anbessa Shoe Factory	Shoes	25
17	AA foam & Plastic Factory	Foam Plastic	17
18	National Chemical Corporation	02,c2h2shoe pol.	173
19	Beer Factory	Beer Malt	900
20	National Distributor Factory	Liquors	175
21	Yakatit Paper Factory	Coverted Paper	30
22	Plastic Factory		51
23	AA Gas & plastic Crates Factory	Creats,Co2 Seats	290
24	Bole Printing Press	Printed Products	16
25	Paint Factory	Paint	40

Table Cont'd

26	Ethiopian Pharmaceutical Fact	Drugs	200
27	Cotton Factory	Cotton Yarn	440
28	Fait Dzabaco Anbessa		20
29	Ablators	Meat	750
30	Ethiopian Spice Extraction fact	Oleoresins	50
31	Repti Soap Factory	Detergent powder & Ba	50
32	Automotive Fact Company		167
33	DairyProdcts Org.	Milk	177
34	Ethiopian Metal Tools Factory	Agricul. Hand Tools	27
35	united Abilities Factory	Dry Cells Umbrellas	210
36	National Dist & Liquors Fact	ethanol	75
37	Abay Soft Drinks Factory	Soft Drinks	360
38	Misrak Flour bakery	Bread Bisc Flour	30
39	Cement Factory	Cement	116
40	Teday Paint Factory	Paint	10
41	Termay Oil Mil Factory	Oil, Ghee	25
42	Addis Ababa Yarn Factory	Cott, Yam Blankets	700
43	AA Car battery Factory	Batteries	4
44	Akaki Oil Mils Factory	Oil, Ghee	47
45	Kokeb Pasta 7 Flour Factory	Pasta Macaron. Flour	100
46	National Dist &Liquors Factory	Ethanol Alcohol	40
47	Canvas & Rubber Factory	Shoes	60
48	AA Tyre Factory	Tyres, Inner Tubes	375
49	Ethiopian Food Corporation (fata)	Food For Children	36
50	Awash Tannery	Leather	800
51	Ethiop Freight Transport Corp.		12
52	Ethio meal Food	Fish Pork Chick Prod	200
53	Crown Cork Factory	Crown Crhcans	12
54	Akaki Textile factory	Blank Sock Text Sheet	1440
55	National tobacco & Matches factory	Tobacco	139
56	Artistic Print	magazines	185
57	Poultry Dev.		665
58	Universal Leather Articles factory	Leather Articles	14
59	Commercial Printing Press		39
60	Nefassilk thread Factory	Embroid & Sewing Thr.	40
61	Ethiop Pikling & Tanning Factory	Pickle & Wet Blue	450
62	Berhan & Selam Printing Press	News Paper	40
63	Kaliti Metal Factory	Metal Doors Wind Frame	15
64	Kaliti Food factory	Bread ,Bis.flour	12
65	Akaki Garment factory	Shirts	81
66	Ethiopian Fibre Prod Factory		96
67	Akski Metal Products Factory	sheets Pipes	715
68	Fana Hollow Blocks Factory	Hot Blocks & Pipes	
69	Akai Spring & Knitting Plant	Cott. Yarn Socks	144
70	Prefab Housing Factory	Prefab Elements	165
71	Kalitit Animal Feed Process Pl.	Cattle Feed	5
72	Kalitit Animal Feed Process Pl.	Cattle Feed	5

Table Cont'd

73	Ethiopian Iron & Steel Foundry	Bars Nails Barb. wires	925
74	OCFA Share Company	Iron & Metal works	10
75	Adwa Flour Mills Factory	Flour Pasta	22
76	Akaki Spare Parts Factory		121
77	Pumps Factory	Pumps	34
78	Yerekesem Factory	Refined Cotton	12
79	Meher fiber Factory	Bags	110
80	Alkyd Resin factory	Alkaline Resin	
81	Engineering Design & Tool Centre Workshop		
82	Electric Bulb factory	Glass Lamps	
83	Addis Ababa Cigarettes factory	Radio and TV	
84	Electronic Product Company (Assemble Pt.		

8.3. Policy Guidelines and Incentives

As it is the case for most developing countries, the industrial development process plays a crucial role in terms of meeting the development aspiration of the people of Ethiopia. Hence, industrialization constitutes the core element of the country's economic policy that is initiated as an "Agricultural Development Led Industrialization. Even if most of the elements that pertain to industrial development are covered under different sectoral and national polices and strategies, the county do not have a comprehensive industrial development policy and strategy. Presently there is no a stand alone and full fledged policy on industrialization in Ethiopia. There is however, a internal document in use by the Ministry of Trade and Industry. This has been termed the "Industry sector strategy and has not been formally adopted by the Government.

The primary groups of sectoral strategies that have significant relevance to industrial development activities in the country are:-

- Investment strategy,
- Privatization strategy,
- Export promotion strategy
- Micro and small-scale enterprise development strategy and
- Quality and standardization strategy...etc

Table 8.9: Indicator for Challenge Area Water and Industry

N0.	Indicators	UNIT	1990-95	96-2000	2001..2015
	WATER AND INDUSTRY				
	Water demand of industry				
	Industrial water use				
	Impact of industry on water quality aspect				
	Policy and guidelines on effluent discharge				

Reference

1. EPA, June 2001. Ecologically Sustainable Industrial Development Project-UNIDO/ETH/99/068 ETHIOPIA, Addis Ababa, Ethiopia.
2. Health Policy
3. MOWR, 1999. Ethiopian Water Resources Management Policy, Addis Ababa, Ethiopia.

Chapter 9

9 Water and Energy Sector

9.1 Background

Energy is a basis for life as well as for development and the per capita energy consumption is the most important indicator of the living standard of a community or a country. Access to affordable and reliable energy underpins sustainable development objectives. Where energy supplies are lacking or insufficient, employment prospects are hindered; children do not have access to adequate education; health concerns remain neglected, and services are insufficient, economic growth is stunted, and the way out of poverty is barred. It is available from the sun, wind, fossil fuel, water, biomass, ocean, etc. The key question, of course is, availability, the relative cost of this energy, sustainability, and environmental acceptability when harnessed for productive use. Except for petroleum, which is wholly imported, Ethiopia is endowed with many types of indigenous energy resources. Renewable energy sources such as hydro, solar, wind, etc. are available in reasonable quantities though they remain largely untapped.

Ethiopia's energy sector, like in many other Sub-Saharan countries, depends highly on biomass. To meet domestic energy requirement, rural population uses various forms of biomass almost exclusively (e.g.: fuel wood, agricultural residues and animal wastes). There is limited use of modern forms of energy and a generally low level of energy consumption. High dependency on traditional fuels results in a considerable pressure on the natural resource system and the country suffers from serious environmental degradation. The effects of population pressure, the expansion of croplands, and high dependency on fuel wood as a major source of rural energy supply has resulted in a serious ecological imbalance in Ethiopia.

9.2 Energy

9.2.1 Historical Energy Sources Level of Supply and Use

The main indigenous sources of energy are biomass, hydropower, fossil fuels, natural gas, coal, geothermal, solar and wind. To meet domestic energy requirements, rural populations use various forms of biomass almost exclusively (e.g.: fuel wood, agricultural residues and animal wastes such as dung). In addition to heavy dependency on biomass, there is limited use of electrical energy and a generally low level of energy consumption.

Ethiopia, whose economy depends almost entirely upon subsistence agriculture, has had little need for electrical energy in the past. Most agricultural products ere exported directly with little processing whose commodities are consumed domestically. There has been awareness in Ethiopia that to raise the standard of living would require a gradual shift from an agricultural economy to one, which processes agriculture surpluses for foreign export as well as the development of other basic light and heavy industries.

In 1954 Ethiopia had about the lowest per capital electrical energy production about 3 kwh per capita. In 1961 this had double to about 6 kwh per capita (USBR, 1964). The first hydroelectric power plant commissioned in 1939 was Aba Samuel hydropower plant, in the Awash basin. The power plant was a storage type and a capacity on 6.6MW generating capacity and followed by the Koka hydroelectric plant in 1960 with an installed capacity of 42MW.

In 1992/93 the energy consumption was amounted to 16.3 MToe with an estimated population of about 52.7 million. The Per capita consumption of commercial energy was 0.02 Toe. The household sector accounted for 87.5% of total energy consumption, while industry accounts for 5%, the commercial sector for about 4% and the transport sector for 3.5% of consumption. The modern energy part, electricity and petroleum fuels cover 1.6% and 5.3% respectively. The household sector relies overwhelmingly on fuel wood and other traditional biomass fuels, which are used mainly for cooking. (ESMAP, 1996).

In, 1999 the total biomass energy supply amounted to 700.92 Peta-joule. Biomass, petroleum products and electricity contributed on an average about 95.06%, 4.27% and 0.67% of the energy supply in the country. From the total modern energy supply, on average, petroleum constitutes 86% and the remaining 14% was derived from electricity, of which 96.7% was from hydro and 3.3% from diesel generator (Asress, 2002).

At the end of 2003, it was estimated that about 92.3% of the total energy source was from biomass and the remaining 6.9% and 0.8% were from petroleum and electricity respectively.

9.2.2 The Energy Sub-Sector Institutional Set-Up

The Ethiopian Electric Power Corporation (EEPCO)

The Ethiopian Electric Light and Power Authority (EELPA), the sole Government agency since its establishment in 1956 was responsible for generating, transmission, distribution and sales of electric energy throughout the country on the principles of commercialization and decentralization of electricity nationwide until it was restructured and reorganized in 1997 and became a public company called EEPCo (Ethiopian electric Power Corporation) with its board of management designated by government.

The Ministry of Rural Development

It was established in 2001, and is responsible for initiating rural development policies, (such as rural electrification) ensuring conducive environment for development are created, supporting regions in expanding rural development as well as monitoring the Food Security Program.

The Ministry of Water Resources

Responsible for formulating national sectoral policies and strategies concerning the protection and utilization of water resources, issuing permits to construct and operate water works, determining the conditions and methods required for the optimum allocation and utilization of water that flows across or lies between more than one regional government. The Ministry of Water Resources has also responsibilities in the study, design and supervision of medium-large scale hydropower projects.

The Ministry of Infrastructure

The Ministry was established in 2001, and one of its responsibilities is to look into the expansion of the energy development in the country and promote the growth and expansion of the country's electric energy supply. It also supervises the activities of the Ethiopian Electric Agency and the Ethiopian Electric Power Corporation.

The Ethiopian Electricity Agency (EEA)

The agency was established in 1997. According to proclamation No. 86/1997, the objective of the Agency is to promote the development of efficient, reliable high quality and economical electricity services. Moreover, it will supervise and ensure that the generation, transmission, distribution and sale of electricity are carried out in accordance with the stated proclamation is a regulatory authority established in 1997.

The Ethiopia Rural Energy Development and Promotion Center (EREDPC)

It was established in 2002 with the objective to create an enabling environment for the development and promotion of rural energy resources and technologies. It is thus responsible among others, to identify the energy resources suitable for the rural areas, study the energy demand, supply and consumption patterns of the rural areas, evaluate the social, economic and environmental impacts of using various energy sources and technologies, raise the awareness of the rural community and provide trainings concerning the production, distribution, utilization and conservation of energy.

The Rural Electrification Fund (REF)

It was established in 2003 with the objectives to provide loans and technical services for rural electrification projects on renewable energy sources carried out by private operators, cooperatives and local communities as well as to encourage the utilization of electricity for production and social welfare purposes in the rural areas. The Fund is to be operated by the Rural Electrification Board and an Executive Secretariat. The Secretariat is responsible among others, to review applications from rural electrification project sponsors and decide upon them based on the criteria set by the Board, sets out criteria for the selection of Trust Agents, prepare directives and selection criteria and procedures for the issuance of loans, promote and support access to and productive use of electricity in the rural areas, as well as facilitate and co-ordinate the rural electrification program activities with other rural electrification programs.

9.2.3 The Primary Energy Resource Base

9.2.3.1 Renewable Energy

Hydropower

The hydro resource of the country is said to be of immense potential. The gross hydro potential of the country is estimated at 650TWh/year (CESEN, 1986). Out of this potential, about 280TWh/year and 161TWh/year is believed to be technically and economically feasible respectively.

Geothermal

This energy resource has proven reserve, which is extended from Danakil depression of Afar Region along the Rift Valley to the Kenyan boarder, About 7000 MW potential exists from geothermal (the Lake district 170 MW, Southern Afar 120MW, Central Afar 260 MW and Danakil Depression 150 MW).

Biomass energy Resources

The country's natural forest which was estimated to have 40% before 50 years (45 million hectares) of the total land area now covers only 27% (3 million hectares) (EFAP, 1994). The total available woody biomass resources are estimated to be around 1,389 million ton in terms of standing stock and about 26 million ton in terms of annual sustainable yield.

Solar energy

Although Ethiopia is endowed with vast solar energy resources, these are not readily used. Because of its proximity to the equator, the country enjoys receiving adequate sunshine throughout the year. For Ethiopia as a whole, the average daily radiation reaching the ground is 5.2 Kwh/m2. The minimum annual average radiation is estimated to be 4.5 Kwh/m2 in July (the main rainy season) to a maximum of 5.55 Kwh/m2 in February and March. The radiation reaching the ground, however, varies significantly from one area- to another as well as from season to season (EEA, 2002).

Wind Power

The wind energy potential of the country varies from place to place and from season to season, as the energy is absolutely seasonal and dependent on the velocity. In the western part of the country, the average wind speed at 10m a.g.l. is 3.5m/s. In the Rift Valley and eastern part of the country, the average values range between 3.5-5.5m/s (CESEN, 1986). From this wind speeds an estimated power level of 65W/m^2 and 200W/m^2 can be obtained. In addition, an average wind speed of 6.7m/s, at 10magl was observed in Recent wind speed measurement carried out in the Mekele area. This justifies that the location is suitable for an economic operation of wind speed turbines.(Benjamin, 2004) ,

9.2.3.2 Non-Renewable Energy

Oil and Natural Gas

Exploration for oil and natural gas has been carried out to date. Recent sub surface drilling data confirmed the presence of 100-120 Million ton of oil shale deposit at Delbi area (Tibebe M., Haile Michael F., 2003). There is also proven natural gas reserve of 108 billion m3 or 2.7 trillion cubic feet in Calub field alone (Asress, 2002).

Coal

A number of coal deposit sites have been identified in certain parts of the country. The total coal deposit of the country is estimated about 178 Million tons (Tibebe M., Haile Michael F., 2003). The deposit quality varies from high quality to lignite category with low heating value, high ash

content and low quality, but some of them can be exploited for household and industrial use as alternative source of energy.

9.2.4 Current Energy Supply and Future Projections

Energy demand generally depends on socioeconomic factors (demography, urbanization, growth and structural changes in the economy, etc.), energy policy (energy prices, substitutions and energy rationalization measures, etc.) and also on the availability of funds for investment and imports. Estimated energy demand projections for the period 2005-2010 are shown in Table 2. The demographic and macro economic variables used to estimate energy demand are: population growth rate 2.9%, urbanization rate 8.5%, GDP growth rate 6%, industrial growth rate 7.4%, agriculture 5.4% and services 7.7% per year. If the past trends and linkages are maintained and no energy rationalization policy is applied, overall energy demand is expected to grow by approximately 3 per cent per year (2.6% for biomass, 7.9% for electricity and 8.7% for petroleum).

Table 9.1: Estimated Energy demand Projection

Fuel	2005		2010	
	TJ	%	TJ	%
Biomass	817622	94.3	929586	92.2
Petroleum	67304	7.8	98435	9.8
Electricity	7990	0.9	12125	1.2
Total	892,916	100	1,040,146	100

Table 9.2: Fuel wood Demand Projection (1000 M3s)

Without Intervention				With Intervention		
Year	Urban	Rural	Total	Urban	Rural	Total
1995	3903	45615	49518	3903	46608	49411
2000	4926	53477	58403	4926	52300	57226
2005	6153	62320	68473	6153	59533	65686
2010	7575	71964	79539	7575	67243	74818
2014	8830	80069	88899	8830	75092	83922

Source: (EFAP, 1994)

The Ethiopian Electric Power Corporation presently maintains two different supply systems; namely, the interconnected system (ICS). Which is mainly supplied from hydropower plants, and the self contained system (SCS), which consists of mini-hydropower plants and a number of isolated diesel generating units that are widely spread over the country. There are a few private generating facilities, mostly of very small capacity, operating outside the EEPCO system. These small installations account for less than 10 % of the total national electricity supply. Currently, EEPCo supplies about 700,000 customers in approximately 600 towns. This represents 15% of the total population of the country. This electricity access is almost entirely concentrated in the urban areas, but although 85% of the population lives in the rural areas, less than 1% has access to electricity service.

In the last three decades, several studies have been carried out to define Ethiopia's energy potential and to develop appropriate investment programs for the power sector. Recognizing the fact that electricity supply along with transportation, water supply and health service is a key element of the physical infrastructure needed for successful improvement of the standard of living of the nation, EEPCo commissioned Acres International in 2000 to review and update the

previous studies and develop 25 years Power System Expansion Master Plan for both its interconnected and self-contained systems. Table 9.3 illustrates the projected supply and demand for the coming 25 years.

Table 9.3: Electricity Projected supply and demand

	Short Term (to 2003)		Medium Term (to 2012)		Long Term (to 2025)	
	Energy (GWh)	**Power (MW)**	**Energy (GWh)**	**Power (MW)**	**Energy (GWh)**	**Power (MW)**
Foecast Demand						
Moderate Scenario	2064	527	3593	856	7507	1770
Target scenario	2065	528	3892	918	9903	2335
Existing and committed supply	2659	654	4035	981	4035	981
Projected Needs						
Moderate scenario	nil	nil	nil	nil	3472	789
Target Scenario	nil	nil	nil	nil	5868	1354

Source: ACRES, 2003,

The study bases its demand forecast on total GDP growth rates of 4.4% for year 2000, an average growth rate of 6.6% per year for years 2001-2005, inclusive, an average of 4.4%/ year for years 2006-2010, inclusive, and 3.1%/year for years 2011-2025. For the year 2000, agricultural, industrial and services sector GDP growth rates are taken as 3.06%, 4.53% and 5.77%, respectively. These relative ratios of GDP growth rates for the agricultural, industrial and services sectors will continue until year 2025, with a slight increase of the growth rate for the industrial sector relative to the agriculture and services sectors.

However, the population growth, coupled with increase energy needs and an anticipated GDP growth rate of more than 6.6% per year with the advances in quality of living and industrialization, EEPCo corporate planning released the following updated plan.

Table 9.4: EEPCo corporate objective

Objectives	**2003/2004**	**2009/10**
Increase Electricity Coverage	14.6%	20%
Increase number of Customers	700,000	1.4 M
Increase number of electrified towns	600	1,200
Increase Per Capita Consumption	25 kwh/y	75 Kwh/h
Increase Electric Power Generation	3,280 Gwh/y	12,367 Gwh/y
Increase Installed Capacity	785 MW	3.000 MW
Increase High Voltage transmission line in Km (400, 230, 132 and 66 KV)	6,304	7,640
Increase Distribution medium and low voltage lines in Km	22,000	33,000

Source: EEPCo, 2003

9.3 Hydropower

9.3.1 Background

The optimum development of water resources is considered to be key element in the socio-economic development of a country. As hydropower does not consume or pollute the water it uses to generate power, it leaves this vital resource available for other uses. At the same time, the revenues generated through electricity sales can finance other infrastructure essential for human welfare. This can include drinking water supply systems, irrigation schemes for food production, infrastructures enhancing navigation, recreational facilities and ecotourism.

Ethiopia has an immense renewable energy potential in the form of biomass, hydropower, geothermal, solar and wind. Ethiopia's economically exploitable hydropower potential is in order of 30,000 MW. However, only less than 2 % of the total potential has been utilized so far. This enormous potential classifies Ethiopia as one of the world's leading countries in hydro potential. Ethiopia is also fortunate in having a combination of vast water resources and suitable topography that permit much of this potential to be developed at a remarkably low-cost, especially in the Blue Nile, Baro Akobo and Omo River Basins of the country.

9.3.2 Water and Energy Sector Policy

The new energy policy issued in May 1994 outlines the need to rely mainly on hydropower to increase the electricity supply but to take advantage of geothermal, solar, wind and other renewable energy resources wherever appropriate. It also calls for the need to encourage energy conservation in industry, transport and other energy using sectors to ensure that energy development is environmentally sustainable; and to provide appropriate incentives to the private sector.

Hydropower development has been accorded due recognition and priority in both the water and energy sector development policies. The current policy of Ethiopia in water resources management has set the overall objective of hydropower development as being " to enhance efficient and sustainable development of the water resources and meet the national energy demand as well as catering for external markets to earn foreign exchange". It is worth noting that the policy ensures all processes of project preparation including surveys, reconnaissance, feasibility studies up to detail design of medium and large scale hydropower projects shall be the responsibility of the water sector" (MOWR, 2000).

On the other hand, the Ethiopia energy policy that was endorsed by government in 1994, accords the following order of priority for the development of various energy resources (MME, 1994).

1) Hydroelectricity development
2) Oil and gas resources development
3) Traditional energy development through reforestation programs.

The principal objective of the hydropower development strategy is to guide the development of potential hydropower resources as permissible by economic feasibility, and by social and environmental constraints, to meet the present and future domestic demand and, if possible, to

generate additional hydropower to cater for the demand of neighboring external markets. Main Elements of the Technical and Engineering aspects of the Strategy are (MoWR, 2001):

- Promote and adapt hydropower development technologies that encourage local level manufacturing of hydro mechanical equipment and spare parts, create employment opportunities, and ensure technological self-reliance on sustainable basis.
- Ensure that an adequate number of HPD candidate sites (small, medium and large) are studied over the planning horizon on a systematic basis so that implementation of feasible schemes is not delayed when financing becomes available.
- Consider hydropower development as an integral part of the multi-purpose development projects to achieve cost reductions in per unit of output produced.
- Negotiate with the neighbouring countries possibilities and arrangements for exporting electricity.
- Prepare inventories of the complete hydropower potential of the country, and identify the site-specific conditions that should be put into place to exploit this potential. Take measures to create those conditions.
- Implement appropriate watershed management measures to ensure long life of hydro dams by minimising siltation of water ways and reservoirs. Consider terracing and reforestation of reservoir boundary belt. Involve local populations to sustain the impacts of watershed management measures.

9.3.3 Number and Capacity of Existing Hydropower Dams

The Power stations currently connected to the ICS have a total installed capacity of 731 MW; of the total energy production more than 98% is from hydropower. Currently 8 Medium-Large scale hydropower plants in the ICS system and 3 small-scale hydro power plants are operational and two hydropower projects are under construction. These are Tekeze and Gilgel Gibe II hydroelectric projects with a capacity of 300 and 420MW-installed capacity. Table 9.5 illustrates the existing hydropower plants in the ICS and SCS system.

Table 9.5: Existing hydropower plants

	Plant	Unit No. X Installed MW Capacity	Dependable Capacity (MW)
1	Koka	3*14.3	38.4
2	Awash II	2*16	32
3	Awash III	2*16	32
4	Finchaa	3*33.3	100
5	Melkawakena	4*38.25	153
6	Tis Abay I	3*3.8	11.4
7	Tis Abay II	2*36	68
8	Finchaa IV	1*34	28
9	Gilgel Gibe I	3*64	184
Total			646.8
11	Yadot*		0.35
12	Sor*		5
13	Dembi*		0.8
Total			6.15
Grand Total			652.85

* *Small hydropower plants in the SCS,*
Source: EEPCO, 2003, 2004

9.3.4 Planned and Under Construction Hydropower Projects

In the last few years, a number of hydro plants have been rehabilitated and commissioned. Power plants, which are under construction and committed are shown below.

Table9.6: Hydropower plants under construction and committed

Station Name	Installed Capacity (MW)	Number of Units	Dependable Capability (MW)	Remark
Gilgel Gibe II	420	3	420	Under Construction
Tekeze	225	3	225	Under Construction
Gojeb	102	2	102	Committed

Table9.7: Yearly Generation Expansion Plan

No.	Year On-line	Plant addition	Unit No X MW Capacity	System Dependable Capacity (MW)
1	2004	Existing		727.7
2	2006	Awash IV	2*17	34
3	2006	Neshe	2*21.5	43
4	2007	Gilael Gibe II	4*105	420
5	2008	Tekeze	4*75	300
6	2009	Gojeb	3*50	150
7	2010	Chemoga Yeda I	2*59	118
8	2010	Chemoga Yeda II	2*45	90
9	2011	Halele Werabessa	2*48	96
10	2011	Halele Werabessa	3*113	339
11	2012	Beles	3*73	219
12	2013	Tendaho Geothermal	2*90	180
TOTAL				2716.7

Source: EEPCo, 2004

Projects to be studied (2002-2016) at different levels (MoWR, 2002) .

- Feasibility studies of 15 medium-large scale hydropower projects.
- Pre-feasibility studies of 18 medium-large scale hydropower projects.
- Reconnaissance studies of 30 medium-large scale hydropower projects.

Categorization of hydropower development projects by executing body

1) For small-hydro schemes (of less than 10 MW), the executing body is the relevant Regional bureau.
2) For studies of medium – and large-hydro schemes, the executing body is MoWR. Exceptions are the studies of Neshe and Awash IV schemes that may be studied by EEPCo.
3) Hydropower development schemes to be developed under interregional programs cannot be defined at this stage ("Nile Basin Initiative" Power Projects)

The Nile Basin Initiative Power Projects include projects that have been proposed from the Ethiopian side for inclusion in the Eastern Nile Subsidiary Action Program (ENSAP) these projects are:

1) The Ethio- Sudan interconnection transmission line.
2) Study and design of four hydropower schemes in the Baro and Abay (Nile) River Basins.

9.3.5 Proportions of Hydropower in Overall Energy Production

The existing ICS is dominated by hydroelectric projects, and several more are under construction or committed for development. Clearly, there is recognition at the national level that the electricity needs of the country could be met primarily through hydroelectric power. The key, of course, is to ensure the most rational exploitation of this resource that meets the needs of the country in the broadest sense. At the end of 2003, it was estimated that about 0.8% of the total energy source was from electricity and of this percentage hydropower accounted more than 98%. Table 9.8 illustrates the proportion of hydropower in the country's electrical energy production in the year 2002/2003.

Table 9.8: Electricity generation in 2002/2003

Plant Name	Energy (Gwh)
Hydro	2023.6
Diesel	40.1
Geo-thermal	0
Total	2063.7

Source: EEPCo, 2003

9.3.6 Integrated Approaches (Multipurpose Use)

In Ethiopia, most large dam projects were implemented by the public power and water supply utility for single purpose. To supply this, there are inevitable competitions and conflicts of

interest between the different water users, and projects that are often plagued by the lack of a cohesive approach.

The Koka dam, Finch Dam and Melka- Wakena Dam were originally planned and designed for a single purpose i.e. to generate power to meet the increasing need of electricity. However, these dams have became useful to regulate the high flood season and supply water for the downstream-irrigated land and water supply for downstream towns and villages after they generate electricity.

There is a growing recognition that planning considerations extend far beyond the interest of single purpose projects, and needed to be viewed at the river basin or with respect to multipurpose development aspects, which results in a number of benefits associated with human well-being such as secure water supply, irrigation for food production, hydroelectric generation, flood control, watershed management, improved navigation, etc. that makes the projects economically viable and environmentally acceptable.

9.3.7 Challenges and Opportunities

Because of rainfall variability and consequent drought, reservoir storage to regulate river flow is needed for power and irrigation needs. Without this facility, sustainable development of the country is challenging. The rapid increase of population necessitates the implementation of large infra-structural development, such as large dams to meet water and energy needs. However, development of large water resource projects has been facing political, social and environmental challenges.

The key challenges to develop hydropower projects in Ethiopia are (Michael, 2003)

- International development policy
- Human & Institutional capacity
- Project risks
- Financial constraints

9.3.8 Impact of Hydropower Dams on the Environment

Any infrastructure development inevitably involves a certain degree of environmental impacts. The construction of a dam and power plant, along with the impounding of a reservoir, creates certain social and physical changes. The critical thing is to explore and anticipate all social and environmental impacts early in the planning process so that appropriate steps can be taken to avoid, mitigate, or compensate for impacts.

The environmental impacts of a water resource project have to be assessed in terms of both its positive and negative aspects, to which adequate attention must be paid. Once the effective measures, in terms of policy, engineering, supervision and management, scientific research as well as investment, etc. are taken and fully implemented to minimize the negative impacts, none of the ecological and environmental issues will affect the feasibility of the project.

Most of the adverse environmental impacts; water related disease; resettlement of people, loss of productive agricultural land, sediment production etc. of the storage water resources projects

occur during construction and the initial 4to7 years of reservoir operation, but they could be successfully mitigated.

Most of the hydropower dams in Ethiopia are situated in the highland area characterized by a climate of marginally suitable for many of the same disease vectors that populate the low land area and some of them are located in deep gorges, forming high waterfalls and rapids as they descend from the highlands, which favored exploitation of the hydropower potential at relatively low unit energy cost and reduce resettlement of people and loss of productive agricultural land.

The potential benefits of these hydropower dams are :

- Economic development and improved quality of life through provision of reliable power supply at lowest possible cost.
- Protects the environment by providing environment friendly energy resource.
- Fuel savings could be made from the large thermal power generation plants.
- Reducing flooding problems in the lowland area due to high intensity torrential rainfall in the high lands.
- Downstream low flow augmentation to better meet minimum flow requirements for water supply, irrigation ,navigation, fisheries ,aquatic ecosystems etc.,
- Leads people out of poverty by enabling small-scale enterprise and off-farm activities
- Enhance economic productivity in providing reliable energy service for industrial development

9.3.9 Impact of Environment on Hydropower Dams

The Koka dam is situated 70km south east of Addis Ababa in the Awash Basin. The basin supports a total irrigated area of some 69 000 ha with the only means of regulation being provided by a single reservoir – Koka. The erosion rates in the Awash basin as a whole and in the Koka catchment in particular are high with values generally in excess of 6 000 t/km2/yr. These high rates of erosion are attributed mainly to the lack of appropriate cultivation and land management practices. Gully erosion often aggravated by infrastructure, is particularly common in the catchment. Koka reservoir provides the regulation of flows for generation at Koka , Awash II and III power plants. The total installed capacity for all three stations is 107.2 MW, which is approximately 21% of the total existing interconnected system capacity.

Sedimentation of Koka Reservoir has been an ongoing problem since first impoundment. The initial total storage of the reservoir, in 1960 was 1 650 Mcm, with a dead storage volume of 180 Mcm. To date, more than 30% of the total volume and almost 96% of the dead volume of the reservoir has been lost to sedimentation.

The general accumulation of sediments in the reservoir has a number of consequences. The most obvious one is the reduction of storage volume. This reduces the reservoir's capacity to regulate flows and therefore will reduce the reliable yield of the reservoir. This will have a negative impact on the annual energy generation from the plant and on the benefits obtained from irrigated agriculture. A secondary impact, although important in the case of Koka, are the reduction in the reservoir's capacity to attenuate flood peaks and operational problems (such as

the blockage of the low level outlet and obstruction of the powerhouse intakes) have already been encountered. In the worst case scenario, which may occur at low operating levels, the power house intakes may even be overwhelmed with sediments which would require the station to be shut down completely and an expensive and time consuming clearing undertaken. This is caused by population pressure, deforestation, poor farming system, etc. in the upper catchments.

9.4 Alternatives Forms of Energy

9.4.1 The Role of Alternative Forms of Energy in the Energy Sector

Alternative non-traditional resources comprise solar and wind energy. These resources while ideal for some specialists' applications, such as serving small and remote or inaccessible sites, are not generally economically competitive with the traditional resources (EEPCo, 2003)

Development in alternative energy technologies has significantly increased the option available for improving rural energy supplies. The main technologies suited to rural areas are micro-hydro, biogas, wind pumps, solar heaters and sustainable ways to provide wood supplies. A more recent development has been the use of photovoltaic systems to provide applications in rural areas. Apart from their environmental appeal, alternative energy technologies have attracted interest all over the rural areas of developing countries.

In the Ethiopian context, although the scope for development of alternative source of energy (solar and Wind) is wider, their contribution in the overall energy scene has remained insignificant. The effort made so far revolved around solar technology demonstration promotion of cooking efficiency and the like. But the impact of this effort on the rural energy problems is nothing more than the expression of the problems of rural areas. This is due to several difficulties and constraints related to the utilization of the solar energy, such that the industry has not fully developed as much as the conventional technology. It can only support uses on a small scale.

Apart from being an alternative to standard, grid-oriented rural electrification, photovoltaic power supplies are widely used in telecommunications. In Ethiopia, about 1200 Kwp of PV applications are installed to-day, of which more than half are for telecommunication purposes and a few hundred solar water heaters and cookers are also operated in the country (Getnet, 2002).

With respect to wind energy, large electricity generating wind turbines are not yet installed in Ethiopia. However, some 100 wind pumps are operating in the country, providing drinking water supply for cattle and humans (Benjamin, 2004).

Costs for these alternative sources tend to be high, largely because of the need to provide electrical energy storage. Solar energy is, of course, only available during daylight hours, while the need for energy for lighting is in the night. Similarly, wind power, while available throughout the entire day, may be variable, from hour to hour being determined by solar heating and the traverse of weather systems through the area.

9.4.2 Impacts of Alternative Forms of Energy on the Environment

Environmental aspects come into play in the three phases of a wind turbine project: building and manufacturing, normal operation during the turbine's lifetime and decommissioning. Negative environmental aspects connected to the use of wind turbines are acoustic noise emission, visual impact on the landscape, impact on bird life, moving shadows caused by the rotor, and electromagnetic interference with radio, television and radar signals. Solar technologies do not cause emissions during operation, but they do cause emissions during manufacturing and possibly on decommissioning.

9.5 The Effect of Various Forms of Energy Production on Climate Change (Greenhouse Gases)

The global environmental concern related to sustainability is the state of our atmosphere. The majority of the deaths are among children in developing countries, who die of acute respiratory infections caused by indoor air pollution resulting from burning fuel wood, crop residues or animal dung for cooking and heating. The main greenhouse gases that have become a point of discussion and debate at international level due to their significance are carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), the chlorofluorocarbons (CFCs) and their substitutes, including hydro fluorocarbons (HFCs), fluorinated hydrocarbons such as per fluorocarbons (PFCs), sulfur hexafloride SF6 and ozone (O3).

According to the Inter governmental panel on climate change (IPCC) greenhouse gas emissions, sources are categorized into six sectors, namely energy, Industrial Processes, Solvents, Agriculture, Land Use Change and Forestry (LUCF) and Waste. Ethiopia's gross CO2 emission, excluding the Land-Use Change & Forestry (LUCF) sector has been estimated at 2,596 Gg for 1994 (Abebe T., 2001). About 88% of this total CO2 emission came from fossil fuel combustion in the Energy sector and the Industrial Processes sector contributed 12% of the total CO2 emissions mainly as a result of cement production.

The total CO2 emission from the Energy sector is estimated at 2,287 Gg for 1994 . This means that energy related CO2 emission per capita is about 0.043 tones and this is a very small amount compared to other countries. With in the energy sector, the Transport (road) sub-sector is the largest consumer of the petroleum imported in to the country followed by the Manufacturing + Construction Industries and the Residential sub-sectors.

There is a general increasing trend of CO2 emission in Ethiopia in the period 1990-1995. The relative comparison of GHG emissions for the years 1990 and 1995 shows that gross CO2 emission (i.e. emissions from the Energy and Industrial Process sectors) have increased by about 24% (Abebe.T, 2001)

9.6 Goals and Strategies for Meeting Future Energy Demand

The limited access to modern forms of energy and their high cost relative to the low average income per capita has reinforced dependence on biomass energy, causing increased deforestation, shortages of fuel wood and degradation of rural eco-systems. Thus, currently, the government is considering the concept and strategy to speed up the development of infrastructure, including electricity in the rural areas. One of the government strategies is to

develop the untapped hydropower potential to improve the supply of affordable electricity, reducing the demand for biomass, and thereby, protecting the watersheds.

The government has set a goal of 20 percent electrification in 2010 (the current rate is 15 percent) as an integral part of its strategy for promoting income-generating activities and social services outside major urban centers to improve living standards and reduce poverty.

EEPCo's strategies to achieve the targeted goal i.e. increasing access from about 15% today to about 20% by 2010, comprises the following.

1) Development of the country's substantial hydropower resources through both private and public sector investment for domestic and export markets.
2) Liberalization of power generation, transmission, distribution, and supply in the isolated areas in order to complement EEPCo's efforts in the interconnected system;
3) Commercialization and decentralization of EEPCo's operations in order to improve operating efficiency, and the quality of services to consumers and to unlock resources for investment in systems expansion; and
4) Strengthening the system of regulation to improve the sector's commercial and operational efficiency.

9.7 Indicators on Afore-Mentioned Issues

Energy is a broad input into human settlements and activities. It is strongly linked to a nation's GDP. Energy indicators provide a measure of efficiency and sustainability in production and ever-day life, and environmental programmes, in terms of energy, should be targeting more efficient and sustainable ways of producing and living.

The major energy carriers in Ethiopia are biomass, liquid petroleum fuels, and electricity. Indicators of energy use are usually expressed as intensive quantities of total energy use, production or consumption, normalized to facilitate comparison. The key indicators described in the following pages consider total energy consumption, access to electricity (Urban and Rural households), Electricity consumption per capita (KWh/capita), Renewable form of energy as percent of total energy, Alternative forms of energy as percent of total energy, Electricity customers, Hydropower plants Installed capacity, Storage dams for hydropower and Small-scale hydropower Plants.

Key Performance Indicators

Indicators	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Total energy production (000'Toe)		14510	14090	14090	15500	15890	16260	16750	17180	17580	18000
Total modern energy consumption (000'Toe)	441	590	730	850	950	1020	1090	1150	1150	1200	1265
Modern energy consumption per capita (Kgoe)	9	11	14	16	17	18	18	19	18	19	19
Electrification level National (%)	1.4	1.6	1.6	1.6	1.6	1.7	1.8	1.9	2.0	2.1	2.1
Urban (%)	10.13	10.41	10.68	10.94	11.41	11.76	12.08	12.36	12.7	12.83	13
Rural (%)	0.13	0.13	0.14	0.16	0.19	0.18	0.16	0.16	0.17	0.17	0.20
Electricity consumption per capita (KWh/capita)		17	16.2	17	17.8	18	18.9	19.3	19.1	19.1	17.2
Renewable form of energy as percent of total energy									97	97	96
Alternative forms of energy as percent of total energy									<0.01	<0.01	<0.01
Electricity generation (GWh)	1129	1147	1278	1389	1470	1554	1604	1610	1650	1670	1812
Hydropower (GWh)									1606	1646	1790
Diesel and Geothermal GWh)									44	24	22
Electricity customers (1000)	400.8	428.8	450.6	472.9	499.6	519.1	535.6	551.8	574.4	594.4	625.5
Hydropower plants Installed capacity (MW)											458
Storage dams for hydropower (No)	3	3	3	4	4	4	4	4	4	4	5
Small-scale hydropower Projects (No) (Installed capacity, 5KW-5MW)					4	4	4	3	3	3	3

Indicators	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total energy production (000'Toe)	18670														
Total modern energy consumption (000'Toe)	1265														
Modern energy consumption per capita (Kgoe)	20	20													
Electrification level	2.2	2.2													
National (%)	13.6	14													
Urban (%)	0.21	0.21													
Rural (%)															
Electricity consumption per capita (KWh/capita)	25	27													
Renewable form of energy as percent of total energy	95	94													
Alternative forms of energy as percent of total energy	<0.01	<0.01													
Electricity generation	2009	2064													
(GWh)	1992	2024													
Hydropower (GWh)	17.6	40.1													
Diesel and Geothermal GWh)															
Electricity customers (1000)	654885	698360													
Hydropower plants Installed capacity (MW)	485	485													
Storage dams for hydropower (No)	5	5													
Small-scale hydropower Projects (No) (Installed capacity, 5KW-5MW)	5	5													

Sources: EEPCO, 2002; 2003; Getnet, 2004; AFREPREN, 2003; IEA, 2003; Karekezi et al, 2002; Teferra, 2003; Phelan, 2003; UNDP, 2003; Wolde Ghiorgis,2003; EIU, 2000-2003.

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Chapter
10

10 Climate Change and Variability

10.1 Observed Climatic Variation

Rainfall is the most important climatological parameter for crop production and forage in Ethiopia. Rainfall patterns are highly seasonal throughout the country except the South-western region which receives rain for 10 months of the year. The South-eastern part of the country has typically a bimodal rainfall pattern with a peak in March-May. The rest of the country has a pronounced summer rain which in normal years supports 85% of the total national food production while the remaining portion is produced in the March-May small rainy season. The highlands above the 150m semi-arid areas primarily support pastoralist.

Other dominant features of rainfall in the country are their variability and quasi-periodicity characterized by anomaly patterns operating on a temporal and spatial scales. According to Workineh (1987), the overall coefficient of rainfall variability ranges from 10-50%. The arid and semi-arid regions which constitute 60% of the country's surface area experience a coefficient of variation of 50% whereas the rainfall fluctuation in the South-Western regions is usually less than 20%. Although long-term records are generally lacking, the potential evapotranspiration in the arid and semi-arid areas exceeds precipitation by a factor of more than 4. The high rainfall deviation together with the high evapotranspiration increases the vulnerability of these areas to drought.

Other climatic processes observed in Ethipoia are variations in the onset duration and distributions of rainfalls which have adverse impacts on food production. Frosts which can destroy crops during their growth are also common occurrences in high altitudes.

10.2 Water Related Disasters and Their Economic and Social Consequences

10.2.1 Drought

Drought and Famine Occurrence

The earliest reference to drought and famine in Ethiopia was in the 9th century. About 30 major drought episodes have been recorded over the last 9 centuries. (Working,1987). 13 of these droughts covered the whole country and were reported to be severe. The remaining droughts and famines differentially affected certain regions with Wollo and Tigray repeatedly affected. 12 of the recorded drought and famines took place in the 20th century out of which 5 occurred during the period under consideration (1972-1991). Most droughts and famines lasted for one year or less except the 1066-1072, 1454-1458,1543-1562,and 1888-1892 famine years which

persisted for over 4 years. The last two decades have been marked by catastrophic and wide spread droughts and famines occurring on the average every 2-3 years as compared to every 7-10 years over the previous decades. The droughts and famine years were 1972-1974, 1975-1976, 1978-1978,1983-1984 , 1990-1991, 1992-1993, 1994-1995, 1997-1998, 2000-2001, 2002-2003 the climatic conditions of these drought years were characterized by either failure, late or early onset of or inadequate rainfalls during the small and/or main rainy seasons. For instance, Workineh (1987) characterized the 1983/84 " Bega" seasons (dry season) as unusually wet month of October followed by prolonged and intense aridity throughout the country and subsequent failure of the small rains. The main rains of 1984 also started late and stopped one month earlier than usual. The total number of people affected by drought episodes for the 1990-2004 period is shown in Table 10.1. The corresponding food assistance requirements are shown in Table 10.2.

Table10.1: Drought Affected Population (1990-2004)

Year	Population Affected	Year	Population Affected
1990	3429900	1998	5820415
1991	1850000	1999	2157080
1992	5228530	2000	7732335
1993	1644040	2001	6242300
1994	889000	2002	5181700
1995	3994000	2003	14490318
1996	3153000	2004	9369702
1997	1932000		

Source: DPPC

Table 10.2: Food Assistance Requirement (1990-2004)

Year	Food assistance Requirements	Year	Food assistance Requirements
1990	374400	1998	572834
1991	838974	1999	1138994
1992	1288737	2000	836800
1993	739280	2001	639246
1994	577586	2002	557204
1995	492460	2003	1461679
1996	253118	2004	964690
1997	199846		

Source: DPPC

Causes of Drought

Climate induced droughts could have many causes encompassing terrestrial atmospheric and oceanic factors. Terrestrial factors include changes in ecological and demographic conditions resulting mainly from rapid population growth estimated at 2.9% per annum and anthropogenic activities such as extensive cultivation and overgrazing. The high population growth has placed increased demands on the nature resources which has led to massive deforestation and devegetation. As a result, vital ecological services of vegetation cover such as control of run-off and soil erosion, replenishment of ground waters and climate regulation are disrupted leading to a "drought-flood cycle" phenomenon. The amount of soil lost is staggering estimated at 2 billiono tons per year. The consequence is massive flooding, decreased rainfall infiltration and

drying up of local streams and rivers once the rains are over. The accelerated local and regional deforestation that has taken place during the last few decades is also believed to have disrupted the subtle hydrological cycles that control rainfall.

Many theories have been developed to explain the meterological droughts arising form anomalous atmospheric circulation. The most accepted cause for meteorological drought in Ethiopia appear to be " the quasi-oscillation of atmospheric circulation triggered by the Sea Surface Temperature (SST) anomaly over the southern pacific and the associated ELNINO/Southern Oscillation (ENSO) events together with SST anomalies over the Southern Atlantic and Indian Oceans" (Tesfaye 1988) . The ENSO events which occur irregularity weaken and dislocate rainfalls causing widespread droughts over the country.

Increase of 0.25°C in minimum temperature over the last 50 years has been observed and this could have also contributed to the rampant drought in the country.

Impact of Drought

The droughts of the last two decades in Ethiopia were major social, environmental and economic disruptive forces. Their impacts were complex ranging from primary to tertiary disorders. The primary and the most immediate shocking effects of drought related famines had been heavy loss of human and livestock population, mass starvation and mass drift to relief centers and nearby towns and cities. Although reliable estimates are not available, famine related deaths are considered to be high. According to a survey made by the Ethiopian Nutrition Institute, the mortality rate for the 1974 famine in Wollo was 190 per thousand of those affected by drought. The 1984-85 drought has claimed more than a million lives (Newsweek, May 20,1991). Drought and environmental degradation are closely inter-linked. Continued environmental degradation increases the risk of drought occurrence while repeated and prolonged drought leads to ecosystem destabilization through the process of soil erosion and desertification. During droughts, the areas affected are denuded of vegetation leaving the soils exposed to wind erosion which in turn leads to fertility decline and forces people to cultivate lands considered marginal so as to maintain previous levels of production. The result is shortened fallow period and expansion of degradation which ultimately may lead to desertification. This process together with the population pressure and the accelerated deforested deforestation have resulted in serious land degradation in the highlands as manifested by declining crop yields, increased frequency of droughts and loss of biodiversity.

10.2.2 Flood

Ethiopian rivers in many cases flow in deep gorges and incised channels in which the flowing water is entrenched. However, there are many areas here and there that are prone to flooding. These include areas affected by flood in Abbay Basin around Lake Tana, the lower reaches of Wabi Shebele, and the vast plains of Baro-Akobo Basin. Flood in the Rift Valley Basin river tributaries, Awash Basin and Omo-Ghibe are also affected in some manner. Flooding in these areas is a phenomena that is happening every year except that the magnitude is changing from year to year. In the lower arid areas where the inhabitants are nomadic pastoralists flood brings moisture to their dry season grazing land to grow enough grass that could last for most of the dry months as such it is not a threat. In some areas where farmers practice flood recede agriculture flood is considered as a beneficial positive impact. The people have developed tradition of living with it. However, flush floods in many areas have resulted in damages to

property and human life. Unlike drought and famine, flood and its consequences have not been properly recorded. The trend over time as a result of global climate change or due to the catchments degradation is not properly documented.

However, the Disaster prevention and Preparedness Commission has identified the following area as flood prone areas for follow-up:

- In Somali Administrative region on the Wabi Shebele from Imi to Mustahil.
- In Gambella Administrative Region on the Baro River from the tow of Gambella to the Border town of Jikao.
- In the Afar Region on the Awash River around Assaita.
- In Amhara Administrative Region Immediately east of Lake Tana where River Ribb and River Gumara enter Lake Rana.
- In Oromia Administrative Region around Tefki in the Teji Depression.

10.3 Management Tools Against Extreme Events

An early warning system is a program established to monitor and warn of the threat of disasters ahead of time, to trigger timely, appropriate, preventive measures. An EWS involves monitoring at household, community, sub-national and national levels.

The scope of the EWS is for: i) slow-onset disasters triggered by 'natural' events: for example droughts. This is the principal type of disaster affecting Ethiopia, where drought depresses agricultural production, which in turn can cause acute food insecurity and eventually famine. The underlying vulnerability of the population is a critical determinant of the impact of drought. Thus, in rural areas of severe poverty, drought is most likely to trigger acute food insecurity and famine. The EWS is geared towards principally to warn of drought related famine by monitoring the agricultural cycle in crop-growing areas, and pastoralists economy in pastoral areas. Ii) Rapid-onset disasters triggered by natural events: for example, by flooding, or health epidemics or earthquake and 'man-made' disasters caused by conflict. The EWS is a traditional system and therefore cannot provide advance warning of conflict. However, it can monitor the impact immediately afterwards and make recommendations for a response. The EWS must also be sensitive to rapid-onset disasters, in order to trigger necessary action in response. Ideally the system should provide advance warning before the disaster happens. Where this is not possible and the disaster occurs suddenly and unexpectedly, the EWS should be able to monitor the impact immediately afterwards and make recommendations for action.

Although the primary objective of early warning is famine prevention, an efficient and effective EWS should provide information which can be used for more general food security and development planning as well, at all levels -national, regional, zonal, and Woreda. Through continuous monitoring the EWS creates a valuable database, both for baseline data and to indicate trends and changes over time in the rural economy.

So far, the EWS has focused on rural areas-where the majority of the population live. It doesn't yet cover urban areas, although this may have to be considered in the future as urban population expands, and poverty and food insecurity become growing urban problems.

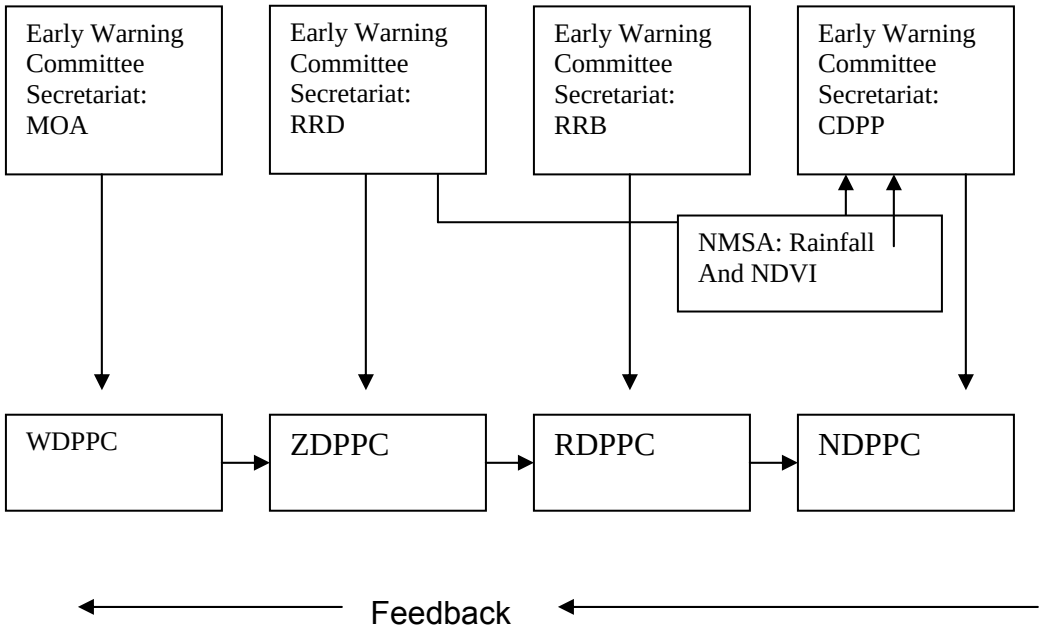
Early warning information is used at different levels. First and foremost , the EWS , which is part of the government, is for use by government offices. Early warning is a technical process of data collection and analysis, designed to provide information to policy-makers and decision makers.

Within the regions early warning information will be used by the Woreda Disaster Prevention and Preparedness , Zonal Disaster prevention and Preparedness committee and Regional Disaster prevention and Preparedness committee respectively, at each level in the administrative hierarchy, enabling them to respond to warnings of deteriorating food security and threatened disaster, if regional resources are adequate. The early warning information is of paramount relevance to Ministry of Agriculture, and the line Ministries involved in some activities, and Ministry of Health responsible for responding to a health epidemic.

At the national level the EWS will enable the commission for Disaster Prevention and Preparedness in Addis Ababa to keep in touch with changing food security conditions around the country, and thus warn the National Disaster Prevention and preparedness Committee for which the commission for Disaster Prevention and Preparedness is the secretariat of impending crisis or disasters so that timely preventive action can be launched, if regional resources are inadequate. If national resources are also inadequate, an international appeal will have to be launched. Information provided by the EWS will also be of use to planners in most line ministries.

Reporting system of the EWS is summarized in the following Figure 10.1

Figure 10.1: Reporting System of the Early Warning System



10.4 Structural Measures Against Disasters

Structural measures for addressing problems of disasters related to drought and flooding have been in use in the Awash Valley for quite some time. Shortage of water down the valley for irrigation has been overcome by releasing water from the Koka reservoir. Accordingly crop losses have been avoided on many occasions. Since last seven years micro-dams, diversion schemes, and water harvesting schemes are being implemented throughout the country, particularly in areas that are characterized by recurrent drought.

Regarding structures for flood control, there is a long tradition of using structures such as dykes and gabions as flood control measures for protection against flood. Dykes have been built at vulnerable sites on most of the existing irrigation schemes. Gabions have been in use as river training structures in the Awash Valley for a long time.

Reservoirs are rarely operated for flood control purposes other than their primary objectives of power generation and irrigation.

10.5 Non-Structural Measures Against Disasters

10.5.1 Land-Use Planning

Development planning which is approved by the Government of Ethiopia in 1978 focused on the National Development campaign, the objectives of which were: to reduce food shortages, to help drought afflicted areas, especially through programs of rehabilitation including reforestation, to eliminate shortages of consumer items and building materials, and to increase foreign exchange earnings by promoting exports. It is to assist this program of the government that the Master Land Use Plan a program assisted by FAO was launched in the same year. The objective of the project was to improve productivity of agriculture through better planning. The program focused on rainfed agriculture . Moisture availability and flood hazard from the point of view of crop requirements have been considered. Irrigation and other water resources aspects were not thoroughly investigated. They were activities left aside for the water sector agencies of the time.

In the early 90's integrated water resources master plans for the river basins was initiated by the Ethiopia Valleys Agricultural Development Authority. Principles of Integrated Water Resources management have been applied as much as possible. However, flood zoning studies were not studied in almost all the master plan studies except in the lower Baro-Akobo basin where all those areas that are flooded for most of the year were excluded from irrigation development from environmental considerations only.

During the time of the Military Government efforts have been made to resettle people from those areas affected by recurrent drought to areas that get enough rain as measure to fight problems associated with drought. In 2002 the Federal Government of Ethiopia issued rural development strategy for Ethiopia, which also promoted the idea of resettling people to areas of reliable rainfall, and better availability natural resources as measures to fight drought related problems. There is no policy or legislation to enforce the Master Land-Use Plan. The River Basin Master Plans and the Resettlement plan are all undertaken without any guiding land use policy or legislation.

10.5.2 Contingency Plans

Emergency situation arises when the life or well-being of victims of natural or man-made disasters will be threatened unless immediate and appropriate actions is taken, and which demands an extra - ordinary response and measures . In this regard contingency planning becomes necessary as a foreword planning process, in state of uncertainty, in which scenarios and objectives are agreed, managerial and technical actions defined, and potential response systems put in place in order to prevent, or better respond to, an emergency or critical situation.

In the Disaster Prevention and Preparedness Commission Contingency plan is made for any possible critical event. The most common are where a new influx or sudden increase in the number of people leaving their villages as a result of drought and following crop failure and escape the eminent hunger.

Contingency Planning begins with situation assessment. In most cases field workers will know simply from experience when it will be prudent to plan.

The planning process follows a set standard where all concerned organizations work together as national committee members on an ongoing process and identify shared objectives and define respective actions.

10.6 Indicators

Indicators for the chapter are summarized in table 10.3 below:

Indicators

Indicator	2002….2015
• Variability in rainfall • Variability in runoff • Trend in minimum temperature • Climate moisture index • Recurrence of drought • Recurrence of flood • Affected population by drought • Food assistance requirements for affected population	

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Chapter
11

11 Water Sharing

11.1 Introduction

The GOE has issued Ethiopian Water Resources Management Proclamation No, 197/2000, dated March 9, 2000. The purpose of this proclamation is to ensure that the water resources of the country are protected and utilized for the highest social and economic benefits to the people of Ethiopia; and to follow up and supervise that they are duly conserved and that the harmful effects of water are prevented.

The proclamation has reiterated as a fundamental principle, the social and economic development programmes, the investment plans, and the water resources development activities shall be based on the Country's Water Resources Policy; the relevant Basin Master Plan Studies and the Water Resources Laws. The management of the water resources of the country shall also be in accordance with a permit system.

Considering the preference among uses, domestic use shall have priority over and above any other water uses; and that pre-allocation of water resources to a given purpose or its being planned, shall not give it priority over and above any other uses.

The MoWR has the mandate to determine the allocation and manner of use of water resource among various uses and users. The Ministry can issue directives, regarding water use restrictions in a situation of water shortage emergency, and supervise the implementation of the same.

The Country is endowed with abundant water resources suitable for various uses. There are several uses of water; and there are several demands. It is ,therefore, essential that such resources are allocated in an equitable and sustainable manner.

11.2 Sharing Water: Definition and Concept

Water is a basic need for all people. Since all need to have water, it calls for water sharing. The rapid growth of population, the development pressure and the changing needs and values require equitable sharing of water among uses and users. Sharing water is allocating water equitably and sustainably among uses for mutual benefits. Management of shared water resources requires balanced and concerted efforts, and participatory approach of all concerned for optimum use and mutual benefits.

11.3 Water Policy and Sharing Water

Water policy refers to actions of government at various levels and in various branches affecting the development, management and allocation of water resources. The policy, here relates to actions affecting the distribution of water among uses and users.

The Water Policy issued by the GOE contains how water should be allocated and apportioned. The policy directs that:

- The basic minimum requirement for basic human and livestock needs as well as environment reserve has the highest priority in any water allocation plan;
- Water allocation gives the highest priority to water supply and sanitation, while apportioning the rest for uses and users that result in highest socio-economic benefits;
- Encouragement of water allocation need to be based on efficient use of water allocation ,which is based on efficient use of water resources that harmonizes greater economic and social benefits;
- Water allocation shall be based on the basin, sub-basin, and other hydrological boundaries and take into considerations the needs of drought prone areas;
- Adopting the principle that water allocations shall not be made on permanent basis, but rather on agreed time horizon that fits best with the socio-economic development plans.

11.4 Water Use Priorities

In principle, all water projects should be first evaluated for multi-purpose potential as a basis for optimizing development. In the planning and operation of systems, water allocation priorities are;

- Drinking Water Supply and Sanitation
- Water supply for livestock
- Irrigation
- Hydropower
- Industrial water supply
- Environment
- Recreational uses of water
- Etc

11.5 Mechanisms for Water Allocation within the Country

In total, at present, the country has a good amount of water amounting to 1800 m3 per capita on average per year. The distribution of available water is uneven over the country. The lowland and drought-prone areas have much less water than the highlands and plateau areas

of the country. This inbalance of water distribution calls for sound water demand management for fair water sharing.

In water projects priority is given, generally, to mulit-purpose projects as compared to single-purpose for optimum water utilization as well as for fair administration of water uses in the reservoir operation. Considering the Water Supply pricing differentials for urban water supply, tariff setting influences water sharing among consumers. When the same flat rates are being applied in several towns at present for consumers that use both public taps and house connections, water sharing among town dwellers is highly affected.

Management of water resources is in accordance with a permit system for uses of irrigated agriculture, commercial animal rearing, industry, mining, urban water supply, etc; while no permit is required for use of water by peasants, artisanal miners, traditional fishermen, traditional irrigation, water mills, hand-dug wells. The supervising Body (MoWR) is responsible for determining the allocation and manner of use of water resources among various uses and users; and for issuing directives to prevent inappropriate use and wastage of water.

11.6 Integrated Water Resources Management (Iwrm)

For optimal utilization of the country's water resources, it is essential and highly beneficial to undertake integrated rather than fragmented approach to water resources development. The Integrated water resources management promotes the coordinated development and management of water, land and related resources to maximize the economic and social welfare in an equitable and sustainable manner. At the fundamental level, the concept of IWRM is concerned with the management of water demand as well as water supply.

The GOE has taken the policy of watershed or river basin as a unit of development and management of both surface and ground water. The Water Policy has recognized and adopted the hydrologic boundary or "basin" as the fundamental planning unit and water resources management domain. It has considered that water resources management is compatible and integrated with other natural resources as well as river basin development plans and with goals of other sectoral developments in health, mines, energy, agriculture, etc.

In the light of the above, River Basin Integrated Development Master Plan Studies have been carried out on six river basins: Abbay River Basin, Baro-Akobo River Basin, Gibie-Omo River Basin, Tekezie River Basin, Wabi Shebelle River Basin and Mereb River Basin. Presently, similar studies are being carried out on Genale-Dawa River Basin. The Master Plan Studies that have been carried out have applied the concept of IWRM in order to maximize the benefits from the natural resources of each basin including water resources. Comprehensive potential projects in water supply, irrigation, hydropower, flood control, fisheries, recreation, navigation, industry, etc have been identified. Priority for development of these projects has been set; and implementation of some has started.

11.7 Transboundary River Basins

Ethiopia has 7 trans-boundary river basins Abbay River Basin; Baro-Akobo River Basin, Tekezie River Basin, Mereb River Basin, Gibie-Omo River Basin, Wabi-Shebelle River Basin and Genale-Dawa River Basin. Integrated Development Master Plan Studies have been

completed for the first five basins, and similar studies are being carried out on the last two basins. Ethiopian Water Resources Management Proclamation, No. 197/2000, dated March 9,2000, issued by the Government has put the water resources of the country to the highest social and economic benefit for Ethiopian people through appropriate protection and due management. The social and economic development programmes, investment plans and water resources development activities shall be based on the country's Water Resources Policy, the relevant Basin Master Plan Studies and Water Resources Laws. Part of Water Policy relating to Transboundary Waters is indicated in Box-11.1

Box-11.1: Water Policy Relating to Transboundary Waters.

- Study on sustainable basis Ethiopia's stake and national development interests in the allocation and utilization of transboundary waters.
- Promote the establishment of an integrated framework for joint utilization and equitable cooperation and agreements on transboundary waters.
- Ascertain and promote Ethiopia's entitlement and use of transboundary water based on those accepted international norms and conventions endorsed by Ethiopia.
- Foster meaningful and mutually fair Regional cooperation and agreements on the joint and efficient use of transboundary waters with Riparian countries based on "equitable and reasonable" use principles.
- Comply with those international covenants adopted by Ethiopia, and manage transboundary waters accordingly.

Water resources of Transboundary Rivers are shared resources of riparian states. Unilateral measures taken will not serve as a means to define the rights of each riparian state. To avert such rivalry, international Law has developed the basic principle, which has gained universal acceptability for sharing the waters of international watercourses. This is the principle of "equitable and reasonable use" of water by all riparian states. The principle of equitable utilization of shared water resources should be taken as a "basic principle" in the allocation of transboundary waters.

11.8 Status of Cooperation in Transbundary River Basins:

With regard to transboundary basins of Ethiopia, there is no comprehensive agreement binding all the water course states. If one takes the Nile River, it encompasses ten Sovereign States. It is paradoxical that Nile is one of very few river basins that show great disparity among the riparian states, between those that contribute almost all the waters but use almost none and those that contribute nothing but use most of its waters.

The basic principle laid down in the Helsinki Rules on transboundary waters was that they have to be shared equitably and reasonably among the riparian countries. One of the most difficult hurdles in dealing with the Nile waters and which is dictating against any form of negotiation is the reluctance to recognize this basic principle of law which has gained universal acceptance.

Todate as far as the Nile is concerned, there is no binding legal and institutional arrangement which acknowledges that all the co-riparian states have rights to its water resources or that these rights are limited in any way and guided by the principle of just and equitable water sharing. In order to lay down the basis for cooperation and efficient utilization of their shared resources, it is imperative that the countries of Nile engage themselves in negotiation to allocate equitably the waters of the Nile.

At present, the Nile basin faces the challenges of poverty, instability, rapid population growth and several environmental degradation. Recognizing this, the Council of Ministers of Water Resources of the Riparian States launched the Nile Basin Initiative (NBI) in February 1999. This initiative provides an agreed basin-wide framework to fight poverty and promote socio-economic development in the Nile Basin. The NBI is a transitional arrangement pending the establishment of a new and permanent legal and institutional framework. The Nile Countries are presently engaged in negotiation on the issue. The NBI is guided by a shared-vision to achieve sustainable socio-economic development through the equitable utilization of and benefit from the common Nile water resources. The Shared-Vision is to be realized through Strategic Action Programmes consisting of basin and sub-basin joint investment projects including expensive sharing and capacity building. The projects consist of"

- Efficient Water Use for Agriculture
- Transboundary Environmental Action Project
- Water Resources Planning and Management
- Nile Basin Power Trade
- Confidence-Building and Stakeholders Involvement, and
- Applied Training

At the Sub-Basin level, The Eastern Nile Subsidiary Action Programme (ENSA) and The Equatorial Lakes Subsidary Action Programme (ELSAP) have been initiated by groups of Riparian Countries for mutual benefits.

11.9 Basin Level Water Institutions

There are ten major river basins in the country; seven of which are transboundary river basins. The water policy of the country under institutional framework has clearly put the establishment of basin-level institutions; and states: "Establish Phase-by-Phase Basin Authorities, for efficient, successful and sustainable joint management of the water resources of the basins through concerted efforts of the relevant shareholders."

Proclamation No.129/1998 has established the Awash Basin Water Resources Administration Agency. This is a purpose of co-ordinating, administrating, allocating and regulating the utilization of the surface water resources of the Awash Basin. This is a start for a limited basin administration; and it is a weak set-up dealing only with part of the basin's natural resources. The Basin Authorities that are being envisaged to be established in the near future will be expected to be independent. The Abbay River Basin Authority (ARBA) is under process to be established very soon; and the other River Basin Authorities are expected to follow.

11.10 Legislation and Regulation

The GOE has issued Proclamation No.197/2000 for the management, protection and utilization of the country's water resources to the highest social and economic benefit for its people through appropriate protection and due management. Detailed regulations for the implementation of the provisions of this proclamation will be issued by the Council of Ministers; and the MoWR issues directives for the implementation of the proclamation.

Management of water resources will be in accordance with a permit system. Directives will be issued regarding water use restrictions in a situation of water shortages. Legal basis for active and meaningful participation of all stakeholders will be provided; and necessary legal framework for penalties commensurate with the violation of legal provisions will be in place. Regulations and directives to implement the proclamation have yet to be issued.

11.11 Public Participation

In water sharing, public participation is highly essential. All stakeholders should have active and meaningful participation. Water Users' Associations, Communities and particularly women should play central role in water resources management activities. The Water Policy provides conducive environment for the involvement of all concerned; though on the ground there is a great deal to go, in particular difficulty of women participation due to cultural reasons.

11.12 Public-Private Partnership

Private sector participation in the development and management of water resources is very limited. The policy of decentralization and the devolvement of power to lower levels are expected to broaden the horizon for better public-private partnership. Currently, the water policy has created conducive situations for involvement of private sector in water resources management; but it has not been very much implemented on the ground regarding water sharing. More effort needs to be made to accelerate the community-government-private sector partnership for better and sustainable management of water sharing.

11.13 Challenges Related To Uses, Management and Governance

An essential condition for the success of a Water Sector Development Programme is the development of adequate capacity for organizational and financial management and technical expertise in the institutions responsible for water resources development and management. The existing lack of adequate capacity in these fields has already been perceived by the government and by major external support agencies. The government is currently committed to carry capacity building measures by undertaking various training programmes at all levels for the water sector with support of ESA. It is considered that such institutional support and capacity building is an essential ingredient to the success and sustainability of water resources development and management. Institutional development and capacity building are being carried out at the federal, regional, zonal, wereda and local levels; with more focus being given to the wereda and local levels.

11.14 Conclusion;

Water is a basic necessity to sustain life. The people of Ethiopia have the fundamental right to have access to potable water supply. Since there are several demands for water, and at the same time water being unevenly distributed in the country, there is a need of fair, equitable and sustainable sharing of water. The water policy provides a conducive environment for water sharing, giving domestic water supply the highest priority followed by water for livestock, irrigation, hydropower, environment, etc.

The country has several transboundary rivers with shared water resources with riparian countries. There is no comprehensive agreement binding all the riparian countries for the use of the shared resources for mutual benefits. It is high-time to have one based on equitable utilization

11.15 Indicators for Water Allocation

Challenge Area …... Water Allocation (Sharing Water)

W A1…… Existence of Water Policy

Indicators:

- Extent of Existing Water Policy implementation on the ground;
- Impact of Water Policy (WP) on Water Resources Development and Management.
- Strength of WP.
- Weakness of WP.

W A2…… Existing Laws for Judicious Distribution of Water

Indicators:

- Extent of implementation of Ethiopian Water Resources Management Proclamation No.197 / 2000 on the ground.
- Provision of Regulations and Directives to implement Proclamation No. 197 / 2000
- Impact of Proclamation No.197 / 2000 on WRDM
- Strength and Weakness of Proclamation No. 197 / 2000

W A3…… Proportion of Water Use

Indicators:

- Magnitude of water demand and supply for Water Supply and Sanitation, Livestock Water, Agriculture, Industry, Hydropower, etc.
- % of water use for Water Supply and Sanitation
- % of water use for Livestock
- % of water use for Agriculture
- % of water use for Industry

- % of water use for Hydropower
- % of water use for Recreation and Ecosystem.

W A4…… Mechanism for Sharing Water

Indicators:

- Water Demand and supply at Normal Time for;
    - Water Supply and Sanitation
    - Livestock Water
    - Irrigation
    - Hydropower
    - Industry
    - etc
- Volume of water allocated as a proportion of total water available during Normal Time for;
    - Water Supply and Sanitation
    - Livestock Water
    - Irrigation
    - Hydropower
    - Industry
    - etc
- Water Demand and supply during Time of Shortage for various uses
- Water allocation for various uses during Time of Shortage as a proportion of total water available
- Priorities of water allocation both at Normal Time and Time of Shortage:
    - Water Supply and Sanitation
    - Livestock Water
    - Irrigation
    - Industry
    - Hydropower
    - etc
- Demand Changes and Distribution (Sectoral)
    - Existing Demands for Various Uses of Water
    - Changes in Demand
    - Distribution of water to fit Changes in Demand
- Transboundary Rivers
    - Seven Transboundary Rivers in the Country
- Cooperative Frame work for Transboundary Rivers
    - No Comprehensive Cooperative frame work binding all Riparian Countries
    - Recent Establishment of Nile Basin Initiative (NBI) among Nile Riparian Countries.
- Need of Water Auditing
- Conflict Resolution for Water Conflicts
- Need of Detailed Planning in Water Allocation
- Reliable Information Collection, Analysis and Dissemination in Planning Water Allocation
- Shared Aquifers
    - No established Shared Aquifers in the country

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Chapter
12

12 Valuing Water

12.1 Introduction

Water has a huge role to play in the socio-economic development of Ethiopia. Since the country has abundant water resources, water should not create a constraint to socio-economic development of the country.

The several rivers and lakes available in the country coupled with good rainfall create a very high potential for water supply, irrigation and hydropower, etc development. Though there is a high water potential there are several factors that hinder sustainable and effective water development. Some of these are:

- Extreme spatial and temporal variability of water, climate and rainfall, coupled with climate change;
- Failure to invest adequately in resource assessment, protection and development;
- Inappropriate government and institutional arrangements in managing national and trans-boundary basins;
- Depletion of water resources through pollution, environmental degradation and deforestation;
- The frequent occurrences of drought and famine;
- Unsustainable financing of investments in water supply and sanitation, livestock watering, irrigation, hydropower, etc.

The above roadblocks pose challenges to the management and development of water resources in the country; and to balance competing demands for basic water supply and sanitation, food security, economic development, and the environment. Therefore, strong and persistent efforts need to be undertaken to stimulate, accelerate and sustain growth in the country's economic development and social well-being.

In consideration of valuing water, one has to take people's social traditions and cultural setting, economic consideration, the need for cost recovery and the ability and willingness to pay. Additionally, several important issues are to be considered, such as: accountability and governance, resource management and allocation, stakeholders participation, gender considerations, investment strategies; public-private partnership; user pay principles, polluter pay principles, technology options, water pricing and financing, etc

12.2 Value of Water: Definition and Concepts

Water is needed in all forms of life. For sustainable development, it is necessary to take into account water's social, economic and environmental aspects.

A clear definition of value of water should recognise the concept of valuing water both as an economic and social good while taking at the same time environmental considerations.

People generally attach religious and cultural values to water. The values of drinking water, domestic uses, irrigation and industrial uses have very often been socially established. The vital role of water for the satisfaction of basic human needs, food security, poverty alleviation, national economy and functioning o f ecosystem is well realised. All costs of those related to urban water supply and irrigation development are to be recovered in Ethiopia according to the Water Policy. This is believed to ensure sustainable water development. Provision of subsidies for those segments of the population who cannot afforded to pay are considered in the policy and the Ethiopian Water Law.

The value of water depends to a large extent on where it is available. Its value is site-specific and also it is time –bound. Water is given more value in the arid, semi-arid and drought-prone areas than in the high land and rain-abundant areas. People, particularly poor people, value a reliable water supply much more than the intermittent, unpredictable supply commonly experienced.

12.3 Valuing Water and Historical Background

The physical features of the country are composed of highlands, plateaus and lowlands. The highlands are mostly associated with high rainfall, several springs, lakes, streams and rivers. Because there is plenty of water in the highlands, people did not value water very much. But in the lowland areas, water is scarce; people give more value to water.

The first piped water supply service was started in Addis Ababa before1900, supplying water to the Imperial Palace. The source of water was a spring located at the foot of Enttoto Hills. Before this date, all people were using traditional sources for their free, non-potable water supply.

After 1900, step by step, water supply services continued to grow; and though nominal, payment for drinking water was started. In almost all towns, irrespective of the amount consumed, flat rates were applied. People getting their water supply from public taps pay more per cubic meter than people having private connections. This means, poor people who pay 10-20 cents per 20 litter-container from the public taps, pay 5-10 Birr per M3; while those with house connections pay 0.50 or 1.00 Birr per m3. Even at present, in certain towns, flat rates are used for all consumptions including public taps (See Table -1). However, due efforts are being made to implement the water policy provisions, so that existing tariffs could be amended.

12.4 Water Policy and Value of Water

The country has rainfall which varies in space and time. There is an abundant water resources, but unevenly distributed. In addition to the above, the absence of well-defined water policy has been one of the major causes, in the past, for the very low performance of water development.

The GOE has formulated and issued a comprehensive Water Resources Management Policy in the year 1999. This water policy is believed to enhance the development of the country's water resources to make optimum contribution to an accelerated socio-economic growth. To translate the water policy in to practice Water Sector strategy has also been developed.

The policy has given due importance and recognition to the value of water. In the general objective of the policy, it has been stated that the development of the water resources of the country is to be for economic and social benefits of the people on equitable and sustainable basis. The fundamental principles of the policy have also highlighted the following, as regard to the value of water:

Water is a natural endowment commonly owned by all the peoples of Ethiopia.

As far as conditions permit, every Ethiopian citizen shall have access to sufficient water of acceptable quality, to satisfy basic human needs.

In order to significantly contribute to development, water shall be recognized both as an economic and a social good; and the policy has clearly recognized the disadvantaged groups of the population by citing that, "Although all water resources development ought to be based on the economic value of water, the provision of water supply services to the under privileged sectors of the population, shall be ensured based on a special social strategy.

12.5 Resource Management and Allocation

To get the optimum benefits from water resources development it is essential to carry out integrated water resources management. The water policy issued by the Government in the year 1999, when fully implemented, creates an enabling environment for water resources development and allocation among competing demands. Since the policy has stipulated that water has to be considered both as an economic and social good, water has to be priced in order to promote economic efficiency, social equity and ecological sustainability.

The most important role of water valuation relates to demand management and better allocation of water among the various uses. The value of water depends on its quantity, quality, location, access reliability and time of availability. Valuing water is linking the concern that water uses must be able to meet different social, economic and environmental functions. Priority in water allocation is given to human and animal consumption, followed by irrigation.

12.6 Water Tariff, Water Pricing and Cost Recovery

Cost recovery from users has not been considered much in the past. Water tariffs did not have relation to the cost of producing water to the consumers. In several urban centres, tariffs are not sufficient even to cover the operation and maintenance costs, let alone capital investment costs. In many places in the country, flat tariffs have been used and remained unchanged for many years; while at the same time the cost of supplying water to consumers has risen steadily (See Table 12.1)

Currently the situation is changing. The present government with its strategy of devolving responsibility to the regional administrations; going down to woreda level and the formulation

and issue of water policy in 1999, water pricing has started to change. The water policy has provided a foundation on which progress for recovering costs could be built. However, the process is still in its early stages, and cost recovery has not been effectively implemented in the whole country yet.

The regions carry the responsibility of providing and running the water schemes. All water supplied to urban towns have to be paid for by the consumers. Individual connections pay according to their metered consumption. Consumers using public fountains pay a public vendor for the quantity that they take.

The tariffs charged to users for water supply are very much lower than the economic cost of supplying water to the consumers. For a long time tariffs for most urban water supplies have not been increased; and the revenue obtained from consumers does not cover even the operation and maintenance costs in several cases. This means that many systems are operating under subsidies from the government. In many cases the standard method of charging for water has been by a flat rate charging0.50-1.00 Birr per cubic meter for consumers whose consumption is metered. The tariff has been applied uniformly, with no differentiation among service standards or amount of consumption for residential, commercial, industrial and public areas. In many places, at public fountains, where the water is sold by public vendors, the water is still charged at the same rate as that for private connections. (See Table-12.1). However, when water from public supplies is scarce or the distance to a public fountain is too great, residents are often forced to buy water from houses with private connections. The private water vendors charge a very high price ranging 10-20 cents for a 20- liter container making the cost of water per cubic meter 5-10 Birr. Currently the situation is being changed for better.

Table 12.1: Flat Water Tariff Rates by Town (Birr / M3)

Town	Year Started	Public Tap	Other conn.by m3 group			
			0-5	5-10	11-30	>30
Harar	1999	0.50	0.50	0.50	0.50	0.50
Jigijiga		1.00	1.00	1.00	1.00	1.00
Assosa		2.50	2.50	2.50	2.50	2.50
Awash		1.50	1.50	1.50	1.50	1.50
Gondar	1995	1.50	1.50	1.50	1.50	1.50
Dessie	1996	1.25	1.25	1.25	1.25	1.25
Bahir Dar	1981	1.25	1.25	1.25	1.25	1.25
Debre Markos	1995	1.50	1.50	1.50	1.50	1.50
Mota	1995	1.75	1.75	1.75	1.75	1.75
Chagni	1995	1.50	1.50	1.50	1.50	1.50
Bati	1995	1.50	1.50	1.50	1.50	1.50
Dejen	1974	1.50	1.50	1.50	1.50	1.50
Lalibela	1995	1.00	1.00	1.00	1.00	1.00
Maychew	1994	1.95	2.00	2.00	2.00	2.00
Abi Adi	1997	2.25	1.75	1.75	1.75	1.75

Source (Abbay R.B. Master Plan Section II – Vol XVII – Part 3)

The tariff set in some regions is higher than others and increases with water consumption. The range is from Birr 0.5 /m3 in Harar for all consumption up to Birr 4.00 / m3 for more than 30 m3 per month in Hagere Salem. Some believe that this may discourage customers from using water that is necessary for their health. Since the amount required for such reasons is low, however, the discouraging effect on personal consumption is small. High tariff are also thought to encourage use of secondary and unsafe sources. For the majority of urban people, however, these sources are used for purposes that do not require safe water.

Most of these tariff structures are not only uneconomical but they are also not equitable. The subsidies made by the government benefit the higher income group of society who have individual connections and who use relatively large quantities of water. Those who buy from public fountains and who receive a much inferior service, with long queues and frequent shortages, pay the same rate per cubic, meter to the public vendor. The public fountain users can afford less to pay the charges than those with individual connections. If the poorest members of a community consider that they can not afford to pay for water from public fountain, there is a great danger that these consumers will continue to use water from traditional sources. These sources are often polluted, and so the community health benefits that would normally be allocated with an improved water supply scheme cannot be achieved.

The water policy that is already in place reflects adequate economic costs; and cost recovery principles have been introduced so that government subsidies in the water sector will be highly minimised or eliminated (See Box – 12.1). The subsidies will be phased out over a period of time, during which tariffs to consumers will be correspondingly increased reflecting the economic cost of water and at the same time considering the communities ability to pay. The policy establishes the guidelines for pricing and cost recovery for urban and rural water supply, industrial water supply, livestock water and charges for irrigation water (See Box 12.1, 2, 3)

Box –12.1: Water Policy Relating to Water Pricing

- Recognize water is a natural resource with an economic value and ensure that fees are paid for services rendered.
- Recognize water as a vulnerable and scarce natural resource and ensure and promote that all pricing systems and mechanisms should be geared towards conservation, protection and efficient use of water as well as promote equity of access.
- Ensure that the price for water should be neither too high (and discourage water use) nor too low (and encourage abuses and over use of water).
- Promote that tariff setting shall be site specific, depending on the particulars of the project, location, the users, the cost and other characteristics of the schemes.
- Ensure that the basic human needs of water for disadvantaged rural communities, who cannot afford to pay for development of water systems, shall be borne by the government, as appropriate, and in so far as the communities are able and willing to cover the operation and maintenance costs on their own.
- Ensure that pricing for urban water supplies shall aim at full cost recovery and develop cross-subsidization strategies and promote credit services.

Box –12.2: Water policy pertaining to Tariff Setting

- Ensure that Tariff structures are site-specific and determined according to circumstances,
- Ensure that rural tariff settings are based on the objective of recovering operation and maintenance costs while urban tariff structures are based on the basis of full cost recovery.
- Ensure that tariff structures in water supply systems are based on equitable and practical guidelines and criteria.
- Establish a “social Tariff” that enables poor communities to cover operation and maintenance costs.
- Establish progressive tariff rates, in urban water supplies, tied to consumption rates.
- Develop flat rate tariffs for communal services like hand pumps and public stand posts.

Box –12.3: Water Policy Regarding the Financing of Water Supply

- Promote self-financing of programmes and projects at the local level.
- Provide subsidies to communities who cannot afford to pay for basic service on capital cost only; based on established criteria and gradually phase of out subsidy.
- Enhance self financed and total cost recovery programs in urban water supplies.
- Ensure that all water supply undertaking will adequately address costs associated with operation and maintenance and be based on"cost-recovery" principle.
- Ensure transparency and fairness in the management of water supply services so as to enhance readiness to pay and participation by the users and communities in the finance management of system.
- Ensure responsibility and financial accountability in the management of water supply service.
- Promote the participation of local banks, other investors as well as popular and traditional self-help social associations (Idirs, rural credit service … etc) in the development of water supply through appropriate incentive mechanism.

Box-12.4: Water Policy for Financing Irrigation

- Establish norms and procedures for financing sustainability and viability of irrigated schemes.
- Promote credit facilities and bank loans for the development of irrigation schemes.
- Develop the appropriate cost recovery systems and mechanisms for all irrigation schemes.

The regions are responsible for setting tariffs. Some of the regions have started establishing new tariffs (See Table – 12.2). The policy directs that setting tariffs has to be site-specific. A separate tariff will be established for each urban town which will be dependent upon the degree of complexity of the water supply system, and hence the cost of operating and maintaining it. The most common methods used for charging water services are flat rates for cases where there are no meters; and a rate which is some functions of the quantity used. Practically all towns with water supply systems use a flat rate for public tap users, and stepped tariff for metered connections. A stepped tariff increases with increased consumption for metered connection (See Table-12.2).

According to water policy, all urban water supplies should have tariffs which will allow full cost recovery including capital loan repayments and full operation and maintenance costs. In order that public fountains users are able to afford with safe water provided from the system, cross-

subsidisation is to be introduced according to the policy by proposing separate tariffs for different standards of service.

In rural areas, where family incomes are generally very low, full cost recovery of water services cannot be achieved for a long time. Therefore rural communities are only to recover costs of operation and maintenance.

Table 12.2: Progressive Water Tariff Rates by Town (Birr/m3) Amhara Region, June 19, 2000

No.	Name of water service	Year Started	Public Tap	0-5 m3	5.1-10 m3	10.1-25 m3	25.1-40 m3
1	Lalibela	2000	1.25	1.00	1.25	1.75	2.00
2	Bahir Dar	2000	1.25	1.50	1.75	2.00	2.25
3	Dessie	2000	1.25	1.60	1.90	2.00	2.50
4	Gondar	2000	1.25	1.75	2.00	2.25	2.50
5	D/Markos	2000	1.25	1.75	2.00	2.25	2.50
6	Debre Zeit	1997	1.00	1.30	1.65	2.00	2.25
	Shashemene	1999	1.50	2.05	2.45	3.05	3.95
	Assela		1.00	1.50	1.85	2.30	2.75
	Ziway	1997	1.00	1.30	1.65	2.00	2.25
7	Kersa		1.00	1.50	1.85	2.30	2.75
8	Awasa	1999	1.25	1.00	1.25	1.50	2.00
	Dilla	1999	1.75	1.50	1.75	2.00	2.50
	Yirga Chefe	1999/00	2.25	1.50	1.75	2.00	2.50
	Leku	1999	1.25	1.00	1.25	1.50	2.00
9	Wenago	1999	1.75	1.50	1.75	2.00	2.50

Source: (Abbay R.B. Master Plan Section II – Vol XVII – Part 3)

Table 12.3: Water Tariff Rates By Town Size Group (Birr/m3)

Town-size Group	No. Town	Public Tap	Other Conns. By m3 Group				Avg. Tariff B/m3	Avg. Cons. lpcd
			0 -5	5 - 10	11 - 30	> 30		
> 80,000	8	1.10	1.21	1.45	1.68	1.90	1.50	25.50
50-80,000	6	1.28	1.47	1.60	1.79	2.04	1.71	17.45
30-50,000	5	1.37	1.45	1.68	1.97	2.36	1.45	17.23
20-30,000	9	1.55	1.63	1.71	1.80	1.86	2.02	17.90
10-20,000	20	1.47	1.50	1.55	1.60	1.70	1.52	12.22
5-10,000	9	1.45	1.68	1.97	2.29	2.68	1.70	15.45
< 5,000	1	1.25	1.00	1.25	1.50	2.00	1.25	17.04
Unweighted Avg.		1.43	1.49	1.63	1.79	1.99	1.62	16.68
Weighted Avg.		1.26	1.37	1.55	1.74	1.95	1.59	20.75

Source: (Abbay R.B. Master Plan Section II – Vol XVII – Part 3)

12.7 Water Financing Requirement, Availability and Gaps

Ministry of water Resources (MoWR) is the federal ministry with overall responsibility for water resources development and management. The water supply and sanitation and the small scale

irrigation activities are the complete responsibility of Regional Bureaus of Regional Governments.

Indicative figures for investment in water sector are shown in Tables 12. 4,5,6. Budget allocated and utilized for the period 1992 – 1999 is indicated in Table12. 4; while budget allocations for 3 years (2000, 2001, and 2002) are shown in Table 12.5. In Table 12.6, budget allocations and utilizations in water sector by source of finance are indicated. Lower utilization of budgets is an indicator of mainly lack of implementation capacity.

Table 12.4 Budget Allocated and Utilized in water sector for 1984 – 1991.

Allocated Budget	**Utilized Budget**
Million Birr	Million Birr
3,256	1,920

Table 12.5 Budget Allocation in 3 years, Million Birr

2000	2001	2002
195	332	195

Table 12.6: Budget Allocation and Utilization in Water Sector, by Source of Finance: (1999 – 2002 inclusive)

Budget Allocation Million Birr				**Budget Utilization Million Birr**			
Gov.	Grant	Loan	Total	Gov,	Grant	Loan	Total
138	283	394	815	114	96	127	337

The government has prepared a water sector development programme for 15 years (2002 – 2016). Physical targets for 15 years in the fields of water supply and sanitation, irrigation, hydropower and general water resources have been drawn up for short-term, medium-term and long-term periods, each covering 5 years.

Indicative investment costs have been estimated for the physical targets envisaged in the WSDP. The financing of the projects in the WSDP is expected to come from the federal government, regional governments, the donors, the NGOs, the Communities, outside loans and the water fund. For the water supply and sanitation alone the investment requirement is estimated to be about 3 Billion USD for the programme period.

To stream line the flow of foreign assistance and loans, the Federal Government has established Ministry of Finance and Economic Development (MoFED). Any bilateral or multi-lateral assistance is negotiated by MoFED in consultations with MoWR and the Regional Governments.

The actual responsibility of loan-signing rests with MoFED. Once the fund is obtained, the contact of the donor agency will be with the MoWR and the Regional Governments.

MoFED has also a major role in local financing of the capital budget for the implementation of projects. The MoWR and the Regions will prepare their respective plans and the required

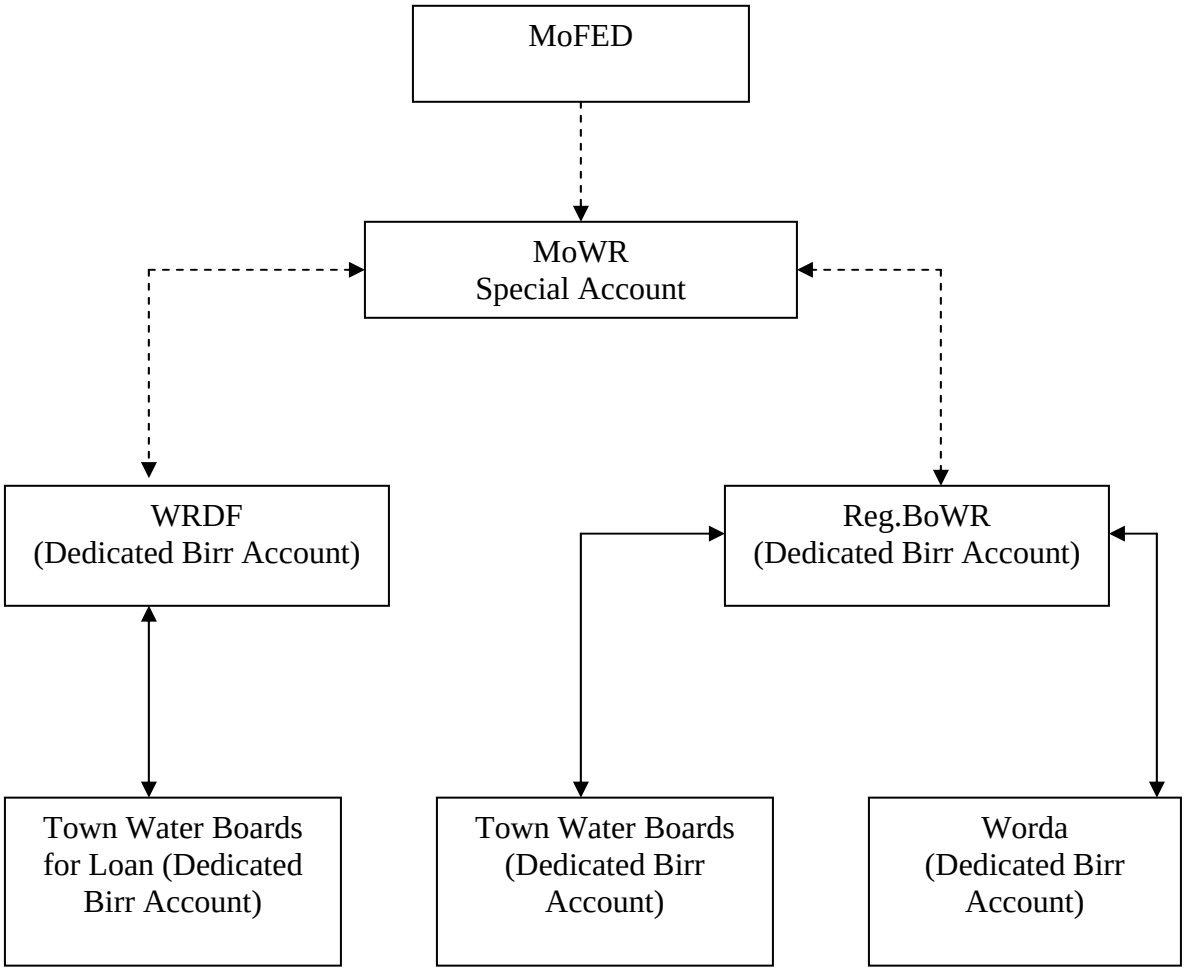
budget for implementation and submit them to MoFED. MoFED will review and consolidate the plans and the budget and submit to the Council of Ministers. The MoWR and the Regions then administer the approved budget.

Non – Governmental Organisations (NGOs) are also major financiers of water projects, mainly water supply and sanitation projects. In the case of NGOs, initiation for financing usually comes from the NGOs themselves.

A Water Fund has been established by the government, which would be used to finance urban water supply and irrigation projects on soft loan basis.

Implementation arrangements will work within established funds-flow channels. Funds will be allocated to the Regions according to the Government's formula; while at the same time maintaining performance-based incentives to encourage Regions. From the point of view of expediting the implementation process, the fund flow goes through the sector offices. Accordingly, special account will be opened at the MoWR level; and then will be transferred to an earmarked account of BoWR. From the BoWR, funds will be transferred to Woreda and Town Water Boards earmarked accounts. (See box-12.5)

Box – 12.5: Schematic Presentation of Flow of Funds for WSS.



Generally, in water supply and sanitation, financial availability will not be far less from financial requirements as long as there is adequate capacity to implement the projects. The gap increases whenever there is a severe lack of implementing capacity.

2.8 Water Technological Options

Water and sanitation services can be better valued if appropriate technologies are selected. The challenge is to identify socially acceptable, appropriate and relatively cheap technologies that can provide sustainable water supply and sanitation services. Low cost technologies for water supply such as hand-dug wells, spring developments, shallow drilled wells, water harvesting, etc form the mainstay of the water supply activities. Alternative technologies for water lifting such as hand pumps, motor pumps, solar powered pumps, windmills and submersible pumps have been used. For sanitation services simple pit latrines, ventilated pit latrine (VIP) and septic tanks are commonly used and are found comparatively cheaper than the more complex ones.

Spring developments with gravity flow are much cheaper than developing spring with pumps. Hand-dug wells with hand-pumps have lower cost than wells with motorized pumps. As far as possible, simple, reliable, low-cost and culturally acceptable technologies are encouraged to be selected for both water supply and sanitation services.

The water policy calls for promoting regular assessment and inventory of the overall situation related to technology in the water sector; and encourages the development of selection criteria for various technologies.

12.9 Legislation and Regulation

A creation of an effective legal and regulatory framework helps considerably to improve the water resources development and management. Relevant proclamations, policies, guidelines and directives have been developed and issued to support water resources development and management.

The legislative frame work includes the Water Resources Management Proclamation (197/2000), the Health Proclamation, Environmental Legislation, and Several Regional Water Supply Management Proclamations, such as Regulation For the Determination of Water Tariffs and Service Charges of the Towns of the Amhara National Region (15/2000), A Proclamation to Provide for the Establishment of Urban Water Supply and Sewerage Service Enterprises of the Oromiya Regional State (78/2004), to mention few.

The Ethiopian Water Resources Management Policy (EWRMP) is a comprehensive statement prepared by the Government regarding water and its use. The policy states that urban schemes should cover all costs; and rural schemes should cover maintenance and operation costs with some allowance for replacements. The policy is to be implemented by all concerned in accordance to the terms and conditions in the national water legislation and the forth-coming regulations to be issued by the government.

12.10 Water Governance

Prior to 1992, the co-ordination of water resources development activities in the country was carried out by the National Water Resources Commission (NWRC), which was established in 1981. The Commission had three authorities and one agency under its umbrella, which acted as the executive arms of the Commission. It also had a Water Resources Council (WRC) that comprised high-level representatives of Government Ministries that dealt with water and related activities.

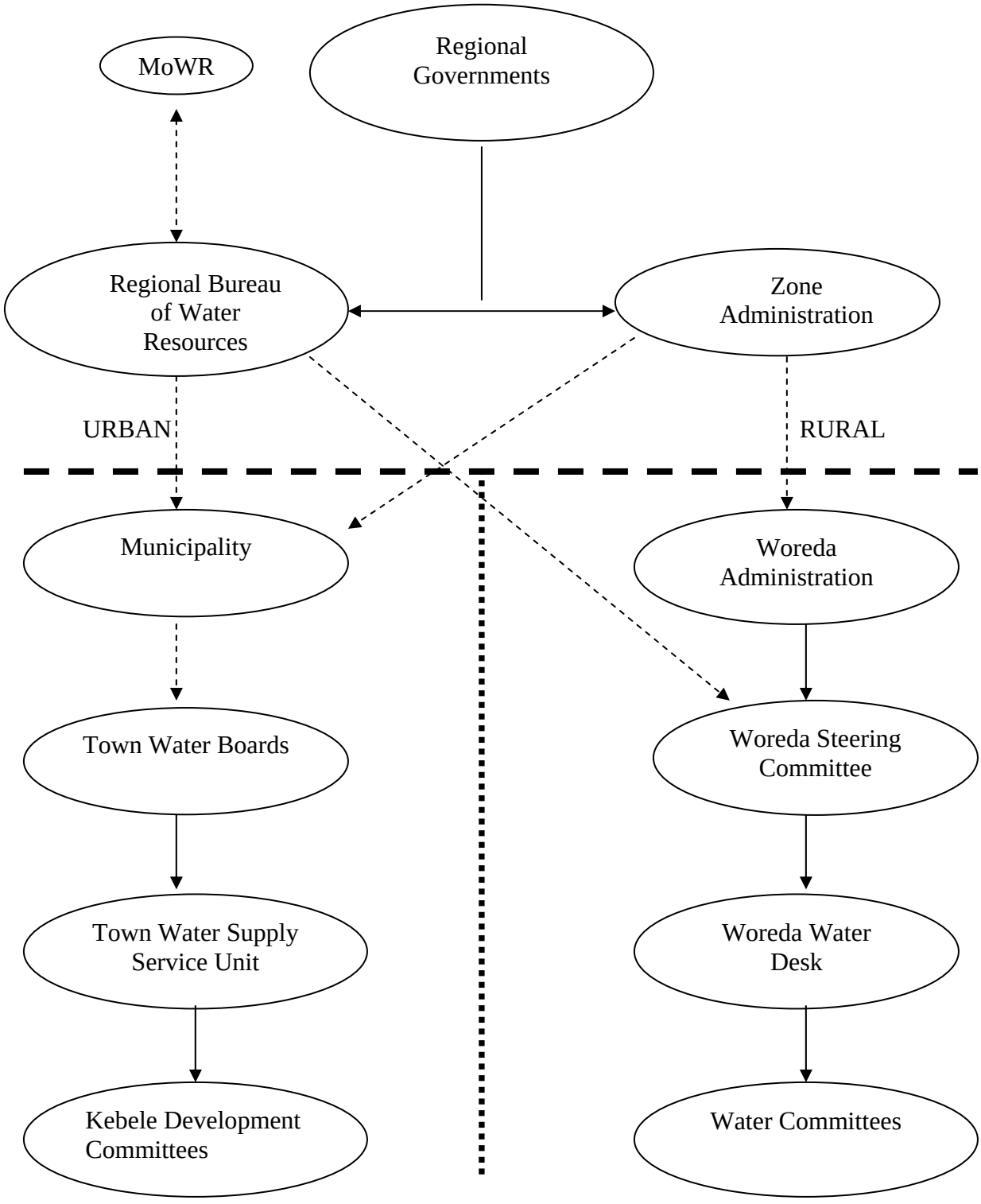
The Ministry of Water Resources (MoWR) was established in August 1995. As a Federal Ministry, it regulates and co-ordinates water resources development and management of the country. It is responsible for forming policies for the water sector at the National level, long term planning strategies, setting of standards and co-ordination of projects and their funding, together with liaising with foreign donor agencies. It also provides technical assistance and advice to the regional governments.

Proclamation No. 41/1993 dated January 20, 1993 delegated authority to the Regional Councils for planning, design, construction, operation and maintenance and management of the water supply and sanitation services. The Regional Governments have taken over the management responsibility for water supply and sanitation operations for both rural and urban areas in the country. In each Region either Water Bureaus or Water, Mines and Energy Bureaus have been created to be responsible for water development and management activities. Because of physical size of the regional states, and partly in recognition of the poor transportation network which hampers communication and for better administration works, each region is divided into a number of zones. Each zone is subdivided into woredas. A woreda is a small administrative sub-district.

Decentralization of government functions and full participation at the community level are crucial features of the federal government's policy. Local communities are expected to take an active role in the planning and decision –making processes regarding community water supply and sanitation. Demand for water supply is presumed to emanate for the community. The village dwellers must show a willingness and commitment to sustaining the scheme once it has been built. The villagers are required to appoint a Village Water Committee who assumes responsibility for the management, operation and maintenance of the community water system. 40-50 % of the committee memberships are expected to be women. The Village Water Communities liaise with the regional administration at woreda level.

Institutional arrangement for developing, implementing, and managing of water supply and sanitation schemes are indicated in figure 12.1, as a sample.

Fig12.1 Institutional Arrangement



Sources: Wss Implementation Manual, April 2004

12.11 Stakeholders Participation

The water policy calls for;

- The identification of the relevant stakeholders for any water resource undertakings;
- The creation of conducive environment for the stakeholders involvement in different water resources management activities;
- The creation of forum for discussions and consultations among the various stakeholders.
- The support of community self-initiatives and direct investment in water resources management; and
- The promotion of direct involvement of communities, particularly women, in the operation and maintenance of water systems.

There are several stakeholders that are involved in the water sector. At the Federal level, the major ones are, Ministries of Water Resources, Health, Agriculture, Finance and Economic Development, Capacity Building, etc; at the Regional level there are Regional Councils, Bureaus of Water; Health, Finance and Economic Development, Mines and Energy, Agriculture, etc; and at zonal level there are zonal administrations, offices of water, health, agriculture, etc. At the woreda level, there are woreda councils, rural development offices, woreda water desks, health desks, Water Users Associations, agriculture desks, Water committees, etc. At the community level, there are Water Boards, Water Committees, Municipalities, Urban Water Supply Service Offices, etc. NGOs, External Support Agencies, Donors, Private Sector, etc are also involved in water resources activities.

In the Water Sector Development Progrmme (WSDP), drawn-up by the Government, for the period of 2002-2016, it has been stated that the local communities, being the primary stakeholders, should be involved from the beginning for all water supply and sanitation activities. They should be empowered to make decisions; and they should be made capable to do so by effective training. In the participatory approach, women have to play greater role and have to participate actively at all levels in the management, operation, maintenance and decision-making of water supply and sanitation schemes. Though slow, this has started to be functioning; and better achievement is expected in due course.

12.12 Water and Gender

It is known throughout the country that women and children are mainly the ones fetching water for the households. The participation of women in the development of water scheme is a determinant factor for its sustainability. Women and children travel long distances some times taking half –a-day, to bring water for the households. In the past, the problem has been that beneficiaries, particularly women, were not involved in the initial stages of water development. At the later stage, they would be called upon to use the scheme without considering whether or not the project is the felt need of the beneficiaries; and, therefore, the sustainability of the scheme is highly affected. Since women are the ones responsible for getting water, they should be encouraged to serve as operators of the system since they are the ones who suffer most if the systems fail.

At the local level, water committees are being established to run water schemes and to look after the operation and maintenance of the systems. At least 2 out of 5 members of the water committees should be women in order to run the schemes. One of the big problems of the water committees is the absence of legal status of Water Committees. Now, this problem is gradually being solved and the water committees have started to be in a better position to run the schemes.

Starting from the year 1999, the water policy gives the right of full involvement of women in the planning, implementation, decision-making and training; as well as empowers them to play a leading role in self-reliance initiatives.

12.13 Public-Private Partnership

One of the options for financing water supply and sanitation facilities is to develop partnerships between public and private sectors. The water policy has included in the policy "the need of development of a frame work for the sustainable and effective collaboration among all stakeholders including the Public Sector, donors, communities and the Private Sector at all levels as well as creating and legalizing forum for the participation of all stakeholders".

The responsibility of implementing the water supply and sanitation projects and program belongs to the Regions. There should be a participatory approach for sustainable and effective implementation of WSDP. The communities, the local governments, the donors, the NGOs and the private sector, etc are the key stakeholders, which play the leading role in executing the program.

The private sector participation in the water and sanitation sector offers the potential benefits of introducing private sector incentives and management skills. The present trend of involvement of private sector in disposing sledges from septic tanks in Addis Ababa is a good sign of active participation of the private sector along with the public sector. Similar involvement of private sector in all activities of WSDP have to be encouraged in areas like study, design, construction, supervision, consultancy, etc. So far the private sector involvement is highly limited. It should be expanded. There are different types of contracts that can be used to involve the private sector in the administration of water supply services. The simple ones are the "service contracts" and "the management contracts" which can be tried initially in order to benefit from the private sector participation. The involvement of service providers in the fields of maintenance and supply of spare parts in the rural water supply services will assist in the sustainability of the schemes.

Privatization of water supply services has not yet stated in the country.

12.14 Financing the Water Sector Development Programme (WSDP)

The WSDP consists of five components:

1) The Water Supply and Sanitations Development Programme (WSSDP);
2) The Irrigation Development Programme (IDP);
3) The Hydropower Development Programme (HDP);

4) The General Water Resources Development Programme (WRDP); and

5) The Institution and Capacity Building Programme (ICBP)

Covering a period of 15 years, from 2002 to 2016; Targets for each component of WSDP have been set; and as an example. the Targets of WSSDP for each Region are shown in Table 12.7

The national water supply coverage is expected to grow from 31% to 76% during the Plan Period; and that of urban water supply from 74% to 98%; followed by the rural water supply coverage from 23% to 71%.

The total financial requirements for the WSDP, including all five components, over the entire planning period (2002 – 2016) are estimated to be US $ 7,445 million (see Table 12.8). The WSSDP constitutes about 39% of the total investment needs, followed by 26% for HPDP, 23% for IDP, 9% for WRDP and 3% for ICBP. Financial requirements estimated for three planning horizons amount to 28% in the short-term, 31% in the medium-tem and 41% in the long-term.

Successful implementation of the WSDP depends very much upon the availability of the financial requirements indicated above; together with the improvements of institutions and implementing capacity as detailed in ICBP. If available resources turn out to be short of what is required, projects within various sub-sectors will be prioritized to make implementation targets compatible with the resource constraints.

The WSDP recommends a series of investments and measures, which emerged through an extensive consultative process for each sub-sector and supporting programme.

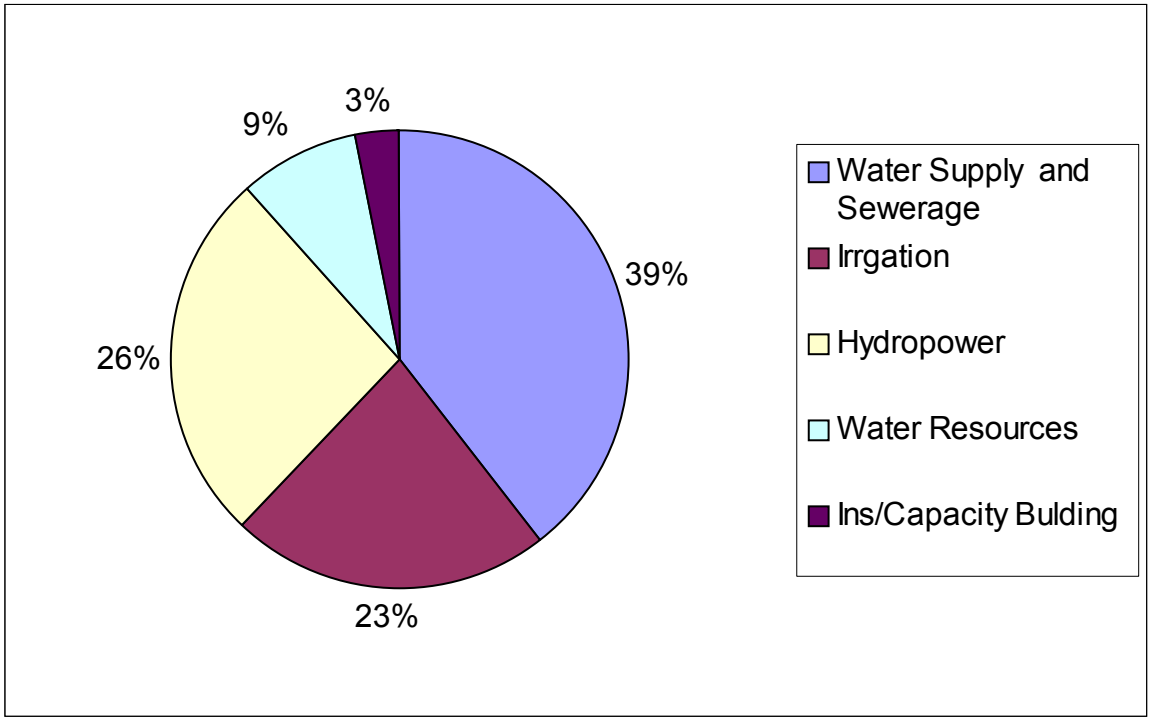
Table 12.7: Targets of the Water Supply and Sewerage Development Program (WSSDP)

	Existing Situation			End of 2006			End of 2011			End of 2016		
Region	**Total Population 000**	**Coverage %**	**Population to be served 000**	**Total Population 000**	**Coverage %**	**Population to be served 000**	**Total Population 000**	**Coverage %**	**Population to be served 000**	**Total Population 000**	**Coverage %**	**Population to be served 000**
Addis Ababa	2,570	70	1,799	2973	95	2,824	3,418	100	3,418	3,883	100	3,883
Afar	1,243	16.5	205	1389	32.6	453	1,540	48.8	752	1,695	65.1	1,103
Amhara	16,748	30.7	5,136	19120	43.2	8,266	27,175	55.5	12,045	24,484	67.3	16,476
Benishangul Gumuz	551	20.3	112	625	40.5	253	706	52.5	371	791	64.5	510
Dire Dawa	330	59.5	196	398	70.6	281	474	92	436	555	97.8	543
Gambella	216	17.6	38	247	28	69	279	44.2	123	311	53	165
Harari	166	22.7	38	196	29.5	58	228	78.7	179	265	90.6	240
Oromiya	23,023	31.2	7,175	26553	47.6	12,632	30,410	65.8	20,019	34,476	83.2	28,685
Somali	3,797	13	464	4329	23.6	1,023	4,919	40.8	2,006	5,537	56.9	3,151
South (SNNPR)	12,903	28.6	3691	14902	38.3	5,709	17,035	50.2	8,548	19,247	71.3	13,725
Tigray	3,797	34.1	1296	4335	52.9	2,293	4,923	72.2	3,557	5,551	92.3	5,122
National	65,344	30.9	20,180	75067	45.1	33,862	85,647	60.1	51,453	96,795	76	73,604

Table 12.8 Summary of overall WSDP investment requirements (US$ millions)

Sub-sector	ST	MT	LT	Total
Water Supply ^^ Sewerage Program	876.2	1,057.9	1,001.7	2,935.8
Federal				
Regional	876.2	1,057.9	1,001.7	2,935.8
Irrigation Program	307.9	456.9	918.3	1,683.1
Federal	114.7	268.1	700.9	1,083.7
Regional	193.2	188.8	217.4	599.4
Hydro power Program	649.1	525.9	776.7	1,951.7
Federal	647.4	516.2	764.5	1,928.1
Regional	1.7	9.7	12.2	23.6
General Water Resources Program	183.9	231.9	240.5	656.3
Federal	133.7	160.1	153.7	447.5
Regional	50.2	71.8	86.8	208.8
Institution/Capacity Building Program	92.9	63.3	61.7	217.9
Federal	13.2	5.3	5.0	23.5
Regional	79.7	58.0	56.7	194.4
Total	2,110.0	2,335.9	2,998.9	7,444.8
Federal	909.0	949.7	1624.1	3482.8
Regional	1,201.0	1,386.2	1,374.8	3962.0

Figure 12.2 Share of Various Programs in the WSDP



The implementation of WSDP activities and projects will involve a good number of partners, each with different roles and functions. These partners include government institutions, private sector, local communities and individuals, NGO's, and external support agencies.

The WSDP is concerned with the way that all social and economic development will be undertaken. The total estimated cost of US$ 7,445 million over 15 years period (2002 – 2016) of WSDP covers all aspects of water resources development and management, and extending to all possible water uses. The source of funding is expected to come from external sources, domestic sources and private capital, both domestic and international in addition to Government treasury.

12.15 Observations

The country has a huge potential of water resources. The development so far is very low be it water supply and sanitation, irrigation, hydropower, etc. This neglect over many years has caused the sector to be characterized by:

- A serious lack of physical facilities for the provision of water supply and sanitation services in both the urban and the rural communities;
- Inadequate engineering and management capacity in the water sector institutions to plan, design, construct, operate and maintain the water schemes.

In the past cost recovery from users has not been properly considered. Water tariffs have to go a long way to bear relation to the cost of producing water for the consumers. In some places tariffs are not sufficient to cover even the operation and maintenance costs, let alone capital investment costs. Most of the present tariffs, in most cases, have remained unchanged for many years; while in the meantime the cost of supplying water to consumers has risen steadily.

The water policy has specified that water is both an economic and social good; water is a basic need and at the same time water has to be paid for. The policy directs that there should be a full cost-recovery for urban water schemes; and for rural schemes, at least operation and maintenance costs should be recovered.

12.16 Indicators for Valuing Water

Challenge Area …. Valuing Water

V W1…. Economic, social, cultural and environmental values are considered in planning water resources

Indicators:

- Economic value of water
- Social value of water
- Cultural value of water
- Environmental value of water

V W2…. Access to Water Supply and Sanitation

Indicators:

- Percentage of Households without access to potable water supply.
- Percentage of House holds using:
    - House connections
    - Yard connections
    - Public Taps
- Proportion of House holds without access to any form of toilet facilities

V W3…. Annual Investments in Various Uses of Water

Indicators:

- Investment in Water Supply and Sanitation
- Investment in Agriculture
- Investment in Industry
- Investment in Environment, etc

V W4…. Urban Water Supply and Sanitation

Indicators:

- Growth of Population in Towns.
- Growth of Water Demand in Towns
- Percentage of Households with access to domestic water supply
    - Proportion of town population using Public Taps
    - Proportion of town people having house and yard connections
- Annual Investment in Urban Water Supply
- Annual Investment in Urban toilet facilities
- Type of Tariffs being used in Urban water supply

V W5…. Rural Water Supply

Indicators:

- Percentage of House holds having no access to potable water supply.
- Percentage of House holds having no access to any form of toilet facilities.
- Annual Investment in Rural Water Supply.
- Tariffs used in Rural Water supply systems.

V W6…. Livestock Watering

Indicators:

- Livestock Population by Type.
- Demand for Livestock Water.
- Annual Investment for Livestock Water.

V W7…. Level of Cost Recovery from Urban Water Supply

Indicators:

- Full cost recovery from Urban Water Supply according to Water Policy.
- Percentage of Urban population that can not afford to pay.
- Percentage of urban population that initially need some kind of subsidy

V W8…. Level of Cost Recovery from Rural Water Supply

Indicators:

- Recovery of Operation and maintenance costs from Rural Water Supply.
- Capital Cost of RWS Schemes as a subsidy to Rural Water Supply systems.
- Mode and amount of contributions of rural communities for rural water supply schemes
- Recovery of some parts of capital cost from some rural communities that can afford to pay.

V W9…. Level of Cost Recovery from Livestock Watering

Indicators:

- Full Cost Recovery from Livestock Watering according to Water Policy.
- Some subsidy at the initial stage for Livestock water schemes for those that can not afford to pay.

V W10…. Level of Cost Recovery from Water Supply for Agriculture

Indicators:

- Full Cost Recovery from Water Supply for Agriculture.
- Some Subsidy for Farmers that can not afford to pay for water for irrigation.

V W11…. Water For Industry

Indicators:

- Amount of water used by Industry as a percentage of total volume of water available.
- Level of production of the industrial effluents
- Pollution Caused by Industries.
- Volume of water recycled.
- Full Cost Recovery for Water Supply for Industry
- Full Cost recovery for pollution caused by Industries

V W12…. Price of Water in Municipal Water Supply Systems

Indicators:

- Type of Tariffs being applied by the Municipal Water Service.
- Tariff for House and Yard Connections.
- Tariff for Public Taps.
- Cost of an unaccounted for water.

- Efficiency of Customer Services
- Charges for Meters and other services

V W13…. Price of Water in Rural Water Supply Systems

Indicators:

- Type of tariff in Rural Water Supply System.
- Contributions of communities to rural water supply services.
- Operation and maintenance costs.

V W14…. Comparison of the Price of water from the public utilities and informal vendors.

Indicators:

- Cost per cubic meter charged by public utilities for
  - House Connections
  - Yard Connections
  - Public Taps
- Distance of customers from Public Taps.
  - Maximum Distance
  - Minimum Distance
- Continuity of providing water supply to customers.
- Customers getting water from Public Taps paying more than those having house connections or yard connections.
- Some customers, in particular poor customers, getting water from private Vendors paying 5-10 times more than customers having house connections or yard connections.

V W15…. Sewage / Sewerage Charges

Indicators:

- Type of sewage to be disposed.
- Availability of Vacuum Trucks to collect and dispose sewage.
- Sewerage charge as a percentage of water tariff.

V W16…. Sources of Investment Funds

Indicators:

- Government Fund
- Loans
- Grants
- Water Fund
- Revenue from sales of water
- Community contributions

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Chapter
13

13 Capacity Building/Knowledge Base

13.1 Education

Government of Ethiopia (GoE) has adopted a new education and Training policy (ETP) in 1994. The policy focuses on increasing access to educational opportunities with enhanced equity, quality and relevance. According to Government official documents this was the basis for the multi-year Educational Sector Development Programmer (ESDP) that started in 1997/98 with the long-term goal of achieving universal primary education by the year 2015. The second phase of the ESDP is continuing for three years similar to that of the PRSP, from 2002/03 to 2004/05.

13.1.1 Types of Schools

There are mainly two types of schools: Government schools and Non-Government schools. The Non-Government schools in Ethiopia include:

- Public schools
- Mission Schools
- Church Schools
- Foreign Community Schools
- Organization Schools

According to the Ministry of Education Grades prior to 1997/98 were grouped as 1 to 6, 7&8 and 9to12 grades for primary, junior secondary and senior secondary respectively. However, according to the new education system, primary grade covers grades 1-8 and Secondary grade covers grade 9-10 and 11-12 academic programme and 10+1 and 10+2 TVET-Technical Vocational Education Training.

13.1.2 Enrolment in Schools

13.1.2.1 Primary School

Coverage of primary education as measured by enrollment in

Grades 1-8, is reported that a rapid expansion during the first four years of the implementation of the ESDP's phase 1has been achieved.

The enrollment in primary grades of Government Schools increased from 4560865 in 1996/97 to 8783287 in 2002/2003(this is in the fourth year of ESDP's implementation). For the same period in the same type of school in non-government schools enrolment was increased from 333924 t0 415742 students.

This is a growth rate of 92.57% in enrollment during the six-year period. (Statistical Abstract 2003 Central Statistical Authority)

Available data in percentage terms show that during the 1996/97-2000/2001 of this same four-year period into the first phase of ESDP implementation, Gross Enrollment Rate (GER) for the first cycle (1-4 grades) primary school increased from 54.8% to 83.0%; for the second cycle (5-8 grades) primary moved up from 17.9% to 30.5% and for the complete (1-8) primary school enrollment raised from 34.7% to 57.4% (SDPRP, MOFED, 2002).

Regarding gender gap for the gross enrollment rates in the first cycle primary level (1-4), the gender gap of 30.2 percentage points in favour of boys in 1996/97 was brought down to 25.1 percentage points in 2000/2001.

However, it has been reported that the gender gap for the whole primary (1-8) has remained constant at approximately 20 percentage points through the four-year period of implementation of the ESDP phase 1. Once the impact of narrowing gender gap in apparent and net intakes move to higher grades of the primary schools, the gap is likely to show a declining trend in the years to come, especially during the second phase of ESDP implementation 2002/03-2004/05.

Urban-rural disparity in primary enrollment is said to have shown a declining trend, while the urban primary enrollment has run at an annual compounded rate of 7.7%, whereas the annual growth rate in rural enrollment is 16.5%.

The rural growth rate is more than double of the urban growth rate of the country for the same period under review.

Student teacher and student-section ratio for the primary grades (1-8) is reported to have increased over the four years (1996/97-2000/2001). The student-teacher ratio increased from 42 at the beginning of the five-year period to 60 at the end of the four-year period, which is an increase of 42%.

The student-section ratio increased from 57.2 to 70.0, which is an overall increase of 22.4%. What one can understand from this figure is that pupil-section ratio is above the standard set (60), which again indicates shortage of classrooms.

The repetition rate for overall primary (1-8) schools has declined from 11.9% in 1996/97 to 9.1% in 1999/2000. It is, however, reported that the declining rate in repetition rate is much more pronounced in grade 1. Primary (1-8) drop out increased from 15.7% in 1996/97 to 17.8% in 1999/ 2000, whereas grade 1 drop out rate has decreased from 29.4% to 27.9% during the same period.

Secondary Schools: A total of 55 new secondary schools were built over the four years of the ESDP phase 1 implementation period. In percentage terms the increase was 15% or annually compound rate of 3.5%.

Total enrollment in senior secondary schools (9-12) increased during these four years from 426,495 in 1996/97 to 736,174 in 2000/2001,which is an overall increase of 72%. This is an annually compounded rate of 14.6%. According to the document reviewed, the rate of growth was found to be identical for boys and girls.

Gross Enrollment Rate (GER) for senior secondary went up from what it was in 1996/97 (8.4%) to 12.9% in 2000/2001, this is an overall increase of 4.5 percentage points. In the same report, GER for girls went up from 7% to 10.9% a slightly reduced rate than that of boys. As a result this has widened the gender gap i.e. 2.9 percent points in2000/2001 in favour of boys.

The major problem or the major bottleneck as they put it in the senior secondary schools is the shortage of qualified teachers. In 2000/2001,out of the total number of 14,029 teachers, only 5127(36%) had qualifications equivalent to first degree or above.

In 2000/2001, there were 13 government and 10 non-government Technical and Vocational Education and Training (TVET) institutions in the country enrolling a total of 4561 students. Government run TVETs enrolled in this same year 2631 students, while the remaining 1930 students were enrolled with non-government run TVETS. 17% of those enrolled were female students.

Besides, there were 25 skill development centers functioning in four regions. A total of 8156 trainees were enrolled with these centers, trainees out of which 2486 (30.42%) were females.

Following the restructuring of the TVETs, in 2001/2002, considerable expansion and diversification is known to have started raising the government run TVETs to 126 and of the private intuitions to 40 TVETs.

13.1.2.2 Higher Learning Institution

Official reports show that the Higher Education Sector has witnessed a very rapid expansion in terms of student enrollment in 20002/2003 in both Government and non-government institutions.

Total student enrollment in the Government run Higher Learning Institutions, such as Universities, Colleges, Technical and Teacher Education Training was 16278 diploma and 30649 degree (i.e. Under graduate programmes).

The numbers of Government Higher Learning Institutions were 6 universities, which have now increased to 8, and 14 other colleges.

Total student enrollment in private colleges for the same year, 2002/2003 was 21706 (Regular students). The number of private colleges during this same period were 16, where only one of them Unity college had a degree programme.

In the school of Graduate studies, there were a total of 1915 students in the year 2002/2003, out of which 13 were enrolled in the former Arba Minch Water Technology Institute (raised its status to a University in mid 2004).

During the period under review, Alemaya and Addis Ababa Universities were the only Higher learning Institutions with Ph.D. programmes, i.e. 34 in Alemaya University and 30 in the Addis Ababa University for the same year.

The total student enrollment in 2002/2003 was therefore 37984 under diploma programmes and a total of 39,093 under degree programmes, which include undergraduate programmes, Master and Ph.D programmes.

Extension (Evening enrollment in the Institutes of Higher Learning for the same period was 45276 under Diploma programmes and 13,909 for Degrees, i.e. a total of 59185 students.

Again if we add all those who attended the Universities, Colleges, Technical Training Institutes in both Government and private were amounting to a total of 136,262 students.

The total number of graduates from the Higher Learning Institutions in various fields of studies from Government run Universities and colleges were 4950 diploma and 17,568 degree, out of which 176 were in irrigation engineering and hydraulics engineering from the then Arba Minch Water Technology Institute.

13.1.3 Non-Formal Education:

Non-formal education in Ethiopia is provided as an alternative to the formal education. The objective is to give basic education programme for all. The basic education programme is known to have three-year cycle and equivalent to formal basic education (1-4). This programme provides education to out- of school children and adults.

Enrollment of the out- of school children (aged 7-14) in 2000/2001 was 320,581 and is reported that it has shown an increase of 14.1% from what it was in the pervious years.

The numbers of youth and adult participants ages 15 and above in the same year was reported to be 1,049, 061.

13.1.4 Indicators

Challenge Area: Capacity Building/Knowledge Base

Specific Area of Challenge: Education

CBI 01: Primary School Enrollment

Enrollment in Government primary schools (1-8) increased from 4560865 in 1996/97 to 8783287 in 2002/2003. During the same period enrollment in private schools increased from 3333924 to 415742. For the complete enrollment in percentage terms for the years 1996/97-2000/2001 it was raised from 34.7% to 57.4%.

CBI 02: Gender Gap

The gender gap for the gross enrollment rates in 1996/97, which was 30.2% in favour of boys was brought down to 25.1% in 2000/2001.

BCI 03: Urban-Rural Disparity

In general Urban-Rural disparity has shown a declining trend, where urban primary enrollment at an annual compounded rate was 7.7%, and the annual growth rate in rural enrollment was 16.5% for the years indicated earlier.

CBI 04: Student-teacher ratio

The student-teacher ratio, which was 57.2 in 1996/97, rose to 70.0 in 2000/2001, an overall increase of 22.4 per cent. Planned pupil-section ratio was to be 60, but the situation shows there were still shortages of classrooms.

CBI 05: Repetition rate

For overall primary school students, repetition rate declined from 11.9% in 1996/97 to 9.1% in 1999/2000. Primary 1-8 drop out increased from 15.7% in 1996/97 to 17.8% in 1999/2000, while grade 1 drop out decreased from 29.4% to 27.9% for the same period.

CBI 06: Enrollment in senior secondary schools (9-12)

Enrollment increased from 426,495 in 1996/97 to 736,174 in 2000/2001 an overall increase of 72%.

CBI 07: Gross Enrollment Rate (GER) in senior secondary Schools

It went up from what it was in 1996/97 (8.4%) to 12.9% in 2000/2001, this was an overall increase of 4.5%. GER for girls went up from 7% to 10.9% during the same period, although at a slightly reduced rate than that of the boys.

CBI 08: Number of Technical and Vocational Education and Training

In 2000/2001 there were only 13 Government and 10 non-government Technical and Vocational Education and Training centers (TVETs) with a total enrollment of 4561 students, out of which 2631 were in the Government TVETs and 1930 were in the non-government. 17% of those enrolled were females. In addition there were 25 skill development centers functioning in four regions. A total of 8156 were enrolled in 2000/2001, out of which 2486 (30.42%) were females.

CBI 09: Student Enrollment in Higher Learning Institutions and Number of Intuitions

The total student enrolled in Government universities, Colleges, Technical and Teacher Education institutions in 2002/2003 were 16278 diploma and 30,649 degree (undergraduate). In the specified period there were 6 Universities and 14 Colleges. Currently, the number of universities has increased to 8.

In 2002/2003 the total number of regular students enrolled with the private colleges were 21,706 and during the same period the number of private Higher Learning Institutions were 16, where only one university had a degree programme.

In the Schools of Graduate Studies there were only 1915 students for the same year (2002/03) out of which 13 of them were enrolled with the Arba Minch Water Technology Institute in three specialized fields of f water resources studies.

The total enrollment for 2002/2003, for all programmes under diploma, undergraduate and post-graduate (Master and Doctorate) programmes were 37984, 39093 and 195 respectively.

CBI 10: Total number of graduates from Higher Learning Institutions

From Government universities and colleges there were a total of 4950 diploma and 17,568-degree graduates, out of which 176 were graduates from the then Arba Minch Water Technology Institute in Irrigation Engineering and hydraulics engineering.

CBI 11: Doctorate Programmes (Ph.D.)

In 2002/2003 Alemaya and the Addis Ababa Universities were the only two with doctorate programmes 34 in Alemaya and 30 in AAU.

CBI 12: Enrollment of out-of school children (Non-Formal programmes)

In 2002/2001 a total of 320,581 were enrolled in non-formal education programmes as an alternative to the final programmes. It is reported that this has shown an increase of 14.1% from the previous years.

The number of youth and adult participants, ages 15 and above for the period indicated earlier was 1,049,061.

13.2 Research

Currently there is no specialized national institution in the country responsible and able to undertake research on different aspects of water resources development and management. The Ministry of Water Resources has recently created a department responsible for R & D in the Water Sector.

In the institution/capacity building development programme of the 15-year Water Sector Development Programme (WSDP), one of the new institutions to be established is the Ethiopian Water Resources Research Centers (EWRRC). Government and many other concerned professionals believe that establishment of such a center could serve as the best means and ways of dealing the immense problems that are impeding sustainable development of the Water resources. It is hoped that it would give technical solutions to problems related to water access and use by the general public.

It would focus on applied research needs that can fulfill and could develop technologies for improved resource management from source to end-user. The Research center would aim at adapting or improving technologies to suit local conditions or develop new technologies.

It would also investigate technical problems in irrigation, hydropower, flood control, drainage, water supply, hydrology, meteorology and management aspects, etc. including those dealing

with demand management (Institution/Capacity Building Sector Development Programme Report, 2002)

It should, however, be noted that research on different aspects of water resources development and management has been going on since mid 1980s under the auspices of the Ethiopian Science and Technology Commission (ESTC).

13.2.1 Research Institutions

As indicated above there are no as such specialized research institutions for water resources in Ethiopia, whatever research is undertaken for any aspect of water resources management and development and other associated issues is known to have continued to be conducted using the competence of institutions outside the water sector, mainly the ESTC.The ESTC, using its Water, Mines and Energy Department, has been Organizing Research Programmes and projects since mid 1980s.

In view of enhancing national research capabilities, the Commission has instituted since 1993 a Local Research Grant (LRG) scheme using Government annual budgets and occasionally support secured from international Agencies such as IAEA and Swedish Agency for Research cooperation (SAREC) of SIDA, Sweden.

Objectives of the LRG scheme is to encourage & assist young and potential researchers to undertake R & D activities and promote research areas that are not usually given due attention, especially by Research Organization and Higher Learning institutions; promote applied research; and raise the standard and quality of local scientific research.

Using this scheme, ESTC grants up to Birr 25,000 (not more than 3000 US$) for a research project and Birr 50,000 (may be not more than 6000 US$) for application of R&D results.

The Water resource is therefore among those sectors that is benefiting from the LRG scheme. This is quite an encouraging step in the absence of a Specialized Research Institute for the water sector.

13.2.2 Fund Allocated for Research

There is no data and information available that tell whether resources of any kind have been allocated for research undertaking through Water Sector Institutions, including the Federal Ministry of Water Resources (MoWR).

However, MoWR has effectively collaborated with the ESTC when the study on Research and Development Activities in the Water Sector has been carried out, a study that was completed in October 2002.

Under the LRG scheme a total of 31 Water and Water related Research Projects have been supported since 1993 up to 2004. Of the 31 projects, 14, 13, 2, and 2 are completed, on going, suspended and discontinued in their order.

Institutions that participated in the research undertaking are universities such as the Arba Minch Water Technology Institute (now Arbaminch University), Addis Ababa University (AAU) (Civil

Engineering Department + Chemistry department), Bahir Dar University and Mekele University, Faculty of Medicine of the AAU and department of Geology and Geophysics (AAU). In addition Regional Water Environmental and Health Bureaux have participated.

Over the past ten years (1992/93-2003/04) the total fund allocated for water and water related research projects under the LRG scheme of the ESTC is US$ 557,448. (ESTC, LRG supported Water Sector Research, 1985 to 1996 E.C)

13.2.3 Masters and Doctorate Level Programmes

Since the school of Post Graduate Studies at the Arba Minch University (AMU) was launched in 2002, three M.Sc Programmes are opened in three specialized fields:

1) Hydraulic and Hydropower Engineering,
2) Irrigation Engineering and
3) Hydrology and Water Management.

The post-Graduate Programme is conducted on tuition fee basis but limited scholarship is also available on competitive basis (Arba Minch University Graduation Bulletin 2003/2004.)

Other than the ESTC supported and organized research undertakings, there are several research organizations/institutes, most of which are under the AAU namely; Institute of Development Research (IDR) Institute of Patho Biology (IPB),

Institute of Ethiopian Studies (IES) Institute of Education Research (IER), and Ethiopian Languages Research Center (ELRC).

Currently Arba Minch University, the former Arba Minch Water Technology Institute (AWTI) is one of the few higher learning Institutions that is undertaking Water and Water related research.

The Ethiopian Agricultural Research Organization (EARO) in the country is responsible for agriculture and agriculture related research undertaking; it also is involved in soil and water conservation studies & research and irrigation related researches.

13.2.4 Indicators

Challenge Area: Capacity Building/knowledge base

Specific Area of the Challenge: Research

CBI13 Number of Research Institutions for Water Resources

There are no Specialized Research Institutions for the Water Sector. However, Research projects/programmes have been undertaken on various issue of the water sector using the competence of institutions outside the water sector and some Higher Learning Institutions mainly the Arbaminch Water Technology Institute.

Water and water related research tasks have been organized and led by the Ethiopian science and Technology Commission (ESTC) using a Local Research Grant (LRG) budget allocated from Government and other sources.

CBI 14 Number of Researches done

Between 1992/93 and 2003/04, the Ethiopian Science and Technology Commission, out of which 14 were fully completed, have undertaken a total of 31 water research projects 13 are on going, 2 are suspended and 2 are discontinued. No information has been obtained about similar research projects that probably have been undertaken by other institutions.

However, the Ministry of Water Resources have recently established a Research and Development Department to coordinate research activities for the Water Resources and is also planning to create Ethiopian Water Resources Research Center in Collaboration with other partners, especially the ESTC and a study to this effect has been completed in 2003.

CBI 15 Budget allocated for Research

Data on total Budget allocated for Research projects related to water are only available from the ESTC, where the data received from show that US$ 557,448 has been allocated or has been funded during the past ten years (1992/93-2003/04). The source of this budget has been Government treasury and support secured from international partners.

CBI 16 Master and Doctorate Programmes

The only specialized Higher Learning Institute that was recently raised to a University level from its former status the Arbaminch Water Technology Institute has Three M.Sc. Programmes in three specialized fields of study opened in 2002.

1) Hydraulic and Hydropower Engineering
2) Irrigation Engineering and
3) Hydrology and Water Management

In the year 2002/2003-programme year, there were 13 graduates at Masters level.

Only two Universities, AAU and AU have currently Master and Doctorate programmes, however, the Programmes they offer are not as such directly related to water resources.

13.3 Collection of Data

Data are generally collected for specified objectives. Institutions require very much to be furnished with timely and reliable data related to their own specific objectives and tasks.

Therefore, adequate and reliable data are required for the purposes of developing and launching short-medium and long-term socio-economic plans.

Most institutions, if not all are generally very much engaged in collecting and collating of necessary amount of data; however, there are specialized institutions like the Central Statistical

Authority (CSA) of the Federal Democratic Republic of Ethiopia entrusted with furnishing socio-economic data related to the wide social and economic activities in the country. Data that this institution furnishes to users are usually both macro and sectorial ones.

13.3.1 Databases

Databases as obtained from the CSA, the specialized institution for furnishing processed data related to social, cultural, national financial and economic accounts and other data and information of interest are included here in view of showing what databases are available for use at any one time that they are needed by potential users. Population, gender, settlement categories expressed in terms of urban and rural areas and health conditions are treated here as they are rightly obtained from the Statistical Abstract 2003 document of the CSA of its January, 2004 publication. In addition to databases with CSA, The Ministry of Cultures and the National Bank of Ethiopia are also the right owners of databases related to the issues indicated here.

Ethiopia is a country of diverse cultures and ethnic groups. There are over 400 small and big ethnic groups or nationalities in the country. Their population size ranges from few thousands in certain cases to a population of millions in the case of the big nationalities. With the democratization process going on in the country, nationalities or ethnic groups have the right to use their own languages in schools and in work places. Law respects ethnic groups' traditions, values, cultures and norms. But this does not mean that there are no traditions being practiced and that should be discouraged using all means and ways of awareness creation mechanisms, a process, which is going on by government and civic society.

13.3.1.1 Social and Cultural Databases

The total population of Ethiopia as of July 2004 is 71,066,000. The rural and urban population as of the dated indicated is 59,867,000and 11,199,000 respectively.

The female population accounts for 35,445,000 while the male population is 35,615,000. They are almost equal.

The population between the ages of 0-29, a very youth age group accounts for most of the population of Ethiopia, totaling to 50,820,056(71.5%) of the total population. The age group, 29-49 is the second highest age group accounting to 13,593,120(20%).

According to CSA's Statistical Abstract of its 2003 issue, the age group 0-49 generally accounts for 64,413,176 (90.64%) of the total population. This shows the greater portion of the Ethiopian population is composed of people of economically productive and at the same demanding so immense amount of economic and social requirements for their livelihood.

Attempt is here again made to present the population of Ethiopia by region, Sex, urban and rural.

There area nine Regional States and Two City Administrations (Addis Ababa and Dire Dawa) under the Federal Democratic Republic of Ethiopia (FDRE).

Table 13.1: Total population of the Regions by Sex, Urban and Rural In thousands

Regions	URBAN			RURAL			GRAND TOTAL		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Tigray	368	378	746	1, 657	1, 710	3, 367	2, 025	2, 088	4, 113
Afar	65	52	171	676	537	1, 213	741	5,89	1,330
Amhara	1,003	1,002	2,005	8,067	8,071	16,138	9,070	9,073	18,143
Oromia	1,601	1,606	3,207	10,923	10,968	21,891	12,524	12,574	25,098
Somalia	361	310	671	1,851	1,587	3,438	2,212	1,897	4,109
Benishangul Gumuz	28	28	56	271	267	538	299	295	594
Southern Nation, Nationalities	578	585	1,163	6,423	6,499	12,922	7,001	7,084	14,085
Gambella	22	21	43	97	94	191	119	115	234
Harari	58	56	114	36	35	71	94	91	185
Addis Ababa	1,348	1,457	2,805	0	0	0	1,348	1,457	2,805
Dire Dawa	136	136	227	49	49	98	185	185	370
Total	5, 568	5631	11,199	30, 050	29, 817	59, 867	35, 618	35, 448	71, 066

Source: Statistical Abstract, 2003, Central Statistical Authority (FDRE)

13.3.1.2 FINANCIAL and Economic Accounts DATABASES

Gross Domestic product (GDP), Gross National product (GNP), GDP per capital and Annual Rate of Growth in Real Gross Domestic product at 1980/81 prices are here provided in order to give a general picture of the Ethiopia national financial and macro economic accounts for the years specified in the table below.

Table 13.2: Summary of National Accounts statistics In Million Birr

	1997/98	1998/99	1999/2000	2000/01	2001/02
GDP	41, 357.9	44926	48785.1	49186.7	46282.2
GNP	41,118.5	44533.9	48296.2	48760.3	45844.0
GDP per capita	756	796.5	842.1	834.9	774.3
Annual Rate of Growth in real GDP	1.4	6.0	5.3	7.7	1.2

Source: Central Statistical Authority, Statistical Abstract 2003.

Table 13.3: General Government Revenue and Expenditures In Million Birr

Budget Year	Revenue			Expenditure		
	Domestic	Foreign	Total	Salary and operating cost	Capital Expenditure	Total
1997/98	8413.1	1271.3	9686.4	7081.3	4146.6	11227.9
1998/99	9557.5	1634.2	112000.7	11099.8	4144.1	15243.9
1999/2000	9982.8	1224.7	11207.5	14399.4	3633.7	18033.1
2000/2001	10573.5	2628.0	13201.5	14466.1	4330.8	18796.9

Source: Central Statistical Authority, Statistical

In the years specified above, domestic revenues in all the years have been on the rise but still less than expenditures. The data above show that Government expenditures have been significantly exceeding revenues, an issue that seriously requires improvement.

What the above data witness is that Government was spending more and above its revenues; salaries and operating costs have always been outstripping capital expenditures by a significant margin. Generally, Government expenditures have been growing over the years more than what is collected in the form of revenues, an indicator of low productivity and savings (1997/98-2000/2001).

13.3.2 Portals and Networks

Data collection in Ethiopia could be done through various means. One can travel from place to place to collect data using road transport, Airlines, postal services and available networks, like telephone and, Internet communication services. In addition, there are national libraries, national museums, national reports and Data and Information Centers plus Public Relation Offices in government and private institutions that can provide users of data and information when and where they are needed. The Ethiopian National Museum and the Addis Ababa museum are good sources of cultural, ethnographic, anthropological, historical artifacts and many others.

2000/01-2002/03 Roads in kilometers were 3941 and 27148 for asphalt and gravel roads respectively.

The other means of transportation to travel to any part of the country to collect data and information would by using the Government owned Ethiopian Airlines and to a limited extent using small air services owned by the private sector. There are times when the Ministry of Defense's helicopters are also used for such purposes.

Postal Services: The Ethiopian postal service, which is another important medium of data transfer, has shown a good progress in terms of delivery of mails, parcels and other goods. Branch post offices are widely available in many parts of the country. Those in major cities and towns are better organized. The Ethiopian Postal Service Government agency is the responsible institution for sending and receiving of letters from domestic and international (to and from), parcels (both domestic and international-in and out) and E.M.S, international and domestic using its branch offices located in many localities of the country.

An organization called DHL is giving a wide range of services in the country for its various customers. Other private agents for transmitting data & information, messages from source to destinations within the country and to and from many parts of the world are as well giving paramount services to various customers using their networks.

Networks: Using the service of the Ethiopian Telecommunication Corporation, one is able to use various types of networks among which fixed telephone lines, mobile phones, Internet, telefax, telegram are to be mentioned among others.

In the case of Internet: Local Area Network, wide Area Network, World Wide Websites (WWW) are becoming very common type of services being provided by the Ethiopian Telecommunication Corporation.

As very rapid expansion of communication services are underway in Ethiopia, the Ministry of Water Resources has established a metadata base (date of data set) and is currently using UN-ECA's website (geoinfo.uneca.org) to provide users the necessary data and information

and at the same time to receive required data and information from partners. Local Area Network and Wide Area Network are networks effectively being utilized by the Ministry. The Ministry has a plan to establish it own website in the near future. The Data and information Center created under the Ministry of Water Resources is the responsible department for networking users with MoWR.

Table 13.4: Total Population of Ethiopia by Sex, Urban and Rural, (in thousands)

Years of Population Report	URGAN			RURAL			URBAN+RURAL (National)		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
July 1998	4299	4392	8691	25772	25419	51191	30071	29811	59882
July 1999	4504	4570	9074	26452	26146	52598	30956	30716	61672
July 2000	4713	4760	9473	27145	26877	54022	31858	31637	63495
July 2001	4924	4962	9886	27851	27607	55458	32775	32569	65344
July 2002	5134	5173	10307	28573	28340	56913	33707	33513	67220
July 2003	5347	5398	10745	29306	29076	58382	34653	34474	69127

Source: Statistical Abstracts 2003, Central Statistical Authority, and 2004 Addis Ababa, Ethiopia

13.3.3 Indicators

Challenge Area: Capacity Building

Specific Area of the Challenge: Data Collection (databases)-social&

Cultural, Financial and Economic Accounts.

CBI18: Urban-Rural population Ratio

Definition for CBI 18: describes the trend of urban-rural population proportions in the last few years, especially for the years specified 1998-2003 inclusive.

The urban-rural population ratios for the years 1998, 1999, 2000, 2001, 2002 and 2003 have been showing an increase from what it was in 1998 (16.8%) to 17.25%, 17.54%, 17.83%, 18.11% and 18.40% respectively. This is an indication of urbanization and of non-farm activities increasingly becoming important.

CBI 19 Male-Female Ratio

Definition for CBI 19: describes the proportion of male and female population size for selected years, in terms of the ratio between the sexes for the years whose data have been obtained. Having a better knowledge and understanding of who accounts for what size of population would help planners to fairly see in to social equity and gender balance perspectives in social and economic benefits and generally in resource allocation and opportunities.

The male-female ratio of the Ethiopian Population is generally of almost equal proportions, although records of the years specified show that there is a slight lead of the male population both in percentage terms and in absolute figures. The ratios for the years 1998, 1999, 2000, 2001, 2002 and 2003 have been 100.87%, 100.78%, 100.70%, 100.63%, 100.58% and

100.52% in favor of male. However, the proportion of male population size in contrast to the female population for the above-indicated years has been on the decrease trend. In a society where the male-female populations are of equal numbers warns how reasonable and rational we should be in terms of gender equity, better explained in terms of the right to access national resources on equality and rational basis. This ratio would simply signify how much planners should be careful in opening equal social and economic opportunities to both sexes if at all required development is to be attend at a faster rate.

CBI 20 National Gross Domestic Product (GDP)

GDP for five successive years of the Ethiopian Fiscal periods are here presented and Annual Rate of Growth in real GDP terms are indicated. In absolute figures the GDP in Million Birr for 1997/98, 1998/99, 1999/2000, 2000/2001 and 2001/2000(CSA) were 41.357.9, 44926 48785.1, 49186.7 and 46282.2 respectively. Accordingly, the real annual rate of growth in real GDP terms for respective years was 1.4%, 6.0 % 5.3%, 7.7% and 1.2%. The sharp decline in real GDP for the year 2001/2002 among other things, is attributed to the sever drought that Ethiopia experienced due to sever shortage of rainfall, which usually seriously affects agriculture in Ethiopia.

CBI 21 GDP Per Capita

GDP per capita for the years specified above had shown increase, except for the last one year (2001/2002), which relatively declined from the previous years. GDP per capita for 1997/98, 1998/99, 1999/2000, and 2000/2001 and 2001/2002 was Birr 756, 796.5, 842.1, 834.9 and 724.3 respectively, showing a growth trend.

CBI 21 Level of Revenues collected and expenditures expended.

Government of Ethiopia's national revenue is mainly from two sources. Firstly, they are collected from domestic sources in the form of government taxes and secondly, they are received from foreign sources in the form of grants and loans. (Please the previous table on Government Revenue and Expenditure). Government is doing its level best since the past few years to increase its revenues from taxes by introducing new tax structures that widens the tax base of the FDRE and the regional states. Tax and financial discipline are also improving through using awareness creation mechanisms and legal instruments as appropriate and required.

In Ethiopia, Government expenditures are mainly composed of salary & operating costs and capital expenditures.

Government expenditures have continued to exceed or to outstrip Government revenues. The general picture of government revenue and expenditure is presented below by taking the case that has been recorded for the years indicated in the table below. Government is spending more and above what it collects in the form of revenues, but the fact that Government expenditures are on the rise at the same time shows that government is spending or allocating a lot of money on social services and economic development interventions that are strongly believed to reduce poverty, health problems of its people and strengthening existing institutions and building and creating new ones. However, Government's effort to narrow the gap between what is collected in the form of national revenues and government expenditures has not been

met, but Government continued relentless efforts to show a significant change in this regard is assumed to bring soon changes in the strength if Government Financial capacity.

Table 13.5: Government Revenue and Expenditures In Million Birr

Budget Year	Revenue			Expenditure		
	Domestic	Foreign	Total	Salary and operating cost	Capital Expenditure	Total
1997/98	8413.1	1271.3	9686.4	7081.3	4146.6	11227.0
1998/99	9557.5	1634.2	11200.7	11099.8	4144.1	15243.9
1999/2000	9982.8	1224.7	112007.5	14399.4	3633.7	18033.1
2000/2001	10573.5	2628.0	13201.5	14466.1	4330.8	18796.9

Source: Central Statistical Authority, Statistical

13.4 Data and Information Dissemination Mechanism

Two main important mechanisms of national data and information dissemination are to be treated in this section namely, Telecommunication and Media & press.

13.4.1 Telecommunications

Telecommunication was first introduced to Ethiopia in 1894, at present the Ethiopian telecommunication corporation (ETC) is the sole government owned and run agency for communication services.

The telephone density in the country (2002) is only 0.6 for every 100 inhabitants. 57.2 percent of the installed telephone lines are accounted for the capital city, Addis Ababa, 32.5 per cent for other major towns in the country and only 10.5 per cent is accounted for the rural areas in the country. The number of telephone lines in absolute figures for 2000/2001, 2001/2002, and 2002/2003 are 283,683,353, 816 and 397,790 respectively.

A total of 667Telephone Call Stations were available in 2002. These telephone call stations are for all the localities in all over the country with an area of 1.2 million kilometer square and of a total population of 67 million. (MOFED Report 2002)

ETC has introduced Internet systems of information since the beginning of 1997/98. Since that time around, the Internet service is growing at a substantial rate. It was first limited to the capital city, but now major towns and cities have become effectively users of the system.

The Internet system has facilities for the transmission of electronic mail, the World Wide Web (WWW), and File Transfer protocol.

In terms of absolute number of users of the Internet service no information have been obtained. However the growth of Internet information system is a fast growing communication technology being used in Ethiopia.

Mobile phones are also widely used in Addis Ababa and in and around major regional cities and towns. Card operated mobile phones are very popular in Ethiopia. The demand for mobile

phones is increasing to a very high level. SMS messages are also used through mobile phones.

13.4.2 Media and Press

Television Service in Ethiopia was first established in 1964. Although for many years the TV service has been confined to Addis Ababa, since 1992 additional installation of new TV branch stations have been carried out in other parts of the country. As of July 2002 TV penetration rate in Ethiopia was at around 55 per cent of the area of the country (MOFED Report 2002).

The Ethiopian Television, the only government owned television station in the country transmits 9 hours on average each day in four languages; Amharic (official language of the FDRE), Oromigna, Tigrigna and English.

To date there is no single private television station in the country.

Radio information Service was first established in Ethiopia in 1935.

Radio Ethiopia is a Government owned station striving to reach almost all localities of the country. It is a multilingual domestic broadcasting service in Amhraic, Oromigna, Tigrigna, Somali, Harari and English. In addition the national radio service is broadcasting in Somali, Afar, Arabic, English and French languages targeting neighboring countries and the locally based diplomatic community. The National Radio broadcasts a continuous service for not less than 13½ hours on average between Mondays and Fridays, and 17 hours on average during Saturdays and Sundays (MOFED Report 2002).

With the exception of a party affiliated (affiliated to the ruling party called EPRDF) radio station called Radio Fana, establishment of Private Radio Stations in the country is not yet permitted.

The Ethiopian Press Agency, A government owned and run press organization publishes and circulates two daily and two weekly News Papers in different languages namely; Addis Zemen in Amharic, The Ethiopian Herald in English, Beresa in Oromigna and AlAlem in Arabhic.

Addis Zemen and the Ethiopian Herald are daily News Papers whereas Beresa and AlAlem are weekly ones.

The Ethiopian News Agency with its 33 branch offices receives and disseminates news to its clients abroad and in the country. Other than this government owned and run agency there is only one News Agency called Walta Information Center again which is affiliated to the Ruling party, but operating as a private entity.

Since 1992 a number of press agents are known to have started operation as private publishing and distributing agencies for various newspapers and magazines. According to one source about 381 licenses were given to such private enterprise during the years 1992/93 to 1996/97 of which only 314 started operations. There were only 13 and 72 press agents in 1994/95 and 1995/96 respectively. However, their number again increased to 113 in 1996/97 (Ministry of Economic Development and Cooperation, 1999).

13.4.3 Data and Information Acquisition and Dissemination in the Federal Ministry of Water Resources

Since 2003, a Water Resources Information and Metadata base Center has been established under the Federal Ministry of Water Resources.

The Center is responsible for organizing spatial and attribute water and water related information in the country. This is done with the collaboration of departments in the Ministry itself.

A metadata (information about data set) is also created with the collaboration of other partners.

Through the established Network for the dissemination of data available, the public and other specialized users can access it in accordance with set procedures of data dissemination and acquisition of the Center. The Data Center also provides geo-referenced data to users and the mechanism for data acquisition is most often project based.

The Ministry of Water Resources in collaboration with its partners is making metadata set and make them available to users through the UNECA website and through the Ministry's Local Area Network (LAN) and WAN. The Ministry has a plan to create its own website in the future.

Through the LAN and WAN, Ministry is now planning to avail users with Arial photographs, Digital Multimedia data, metadata, documents, articles, and tabular data, which are related to the Water Sector.

The Mechanisms established by the MoWR to disseminate whatever available data and information to users are LAN and WAN Networks and the website mentioned above, UNECA website called geoinfo.uneca.org to disseminate metadata to the public.

Generally, by consulting the Ministry's Data and Information Center, one can get real or actual data provided that he fulfills required procedures.

13.4.4 Indicators

Challenge Area: Capacity Building/knowledge base

Specific Aspect of the challenge: Data and Information Dissemination Mechanism

CBI 17: Number of telephones

According to the Ethiopian Telecommunication Corporation the telephone density in 2002 was 0.6 per 100 inhabitants. The number of telephone lines in absolute figures for 2000/2001, 2001/2002, and 2002/2003 were 283,683, 353,816 and 397,790 respectively. There are also Telephone Call Stations for specified locations in many parts of the country. In 2002 the number of Telephone call stations for all the localities (number of localities are not known) were 667. These Telephone call stations are for the country of 1.2 million square kilometers and for then population of 67 million (2002).

CBI 18: Internet and Mobile Phones

Internet systems of information have been introduced for the first time in 1997/98. Addis Ababa, the capital city and major towns and cities of the regional states are the major users of Internet. The Internet system has facilities for the transmission of electronic mail, WWW and File Transfer Protocol. Mobile phones are also widely used in Addis Ababa and in most parts of the country, especially in the major cities and towns and their surroundings.

CBI 19: Radio and Television Services

There is only one Government owned and run Television service covering around only 55 per cent area of the country. This national Television service transmits on average 9 hours each day in four languages - Amharic, Oromigna, Tigrigna and English. So far there is no single private Television station in the country. Television service in Ethiopia was first established in 1964. For many years after it was established, its services were confined to the city of Addis Ababa, but since 1992 many new branch stations have been established in many parts of the country. With the knowledge of the Ethiopian Telecommunication Corporation Satellite Dishes are also widely used in the country.

The Ethiopian Radio Service has been established in 1935. It broadcasts in its multilingual services in six languages - Amharic, Oromigna, Tigrigna, Somali, Harari and English daily on average for not less than 13½ hours between Mondays and Fridays, and 17 hours on average during Saturdays and Sundays (MOFED Report 2002). With the exception of one ruling party affiliated Radio station called Radio Fana, there is no private Radio station in the country. The other public radio service is the FM Radio, which covers Addis Ababa and some few locations nearer to the city

CBI 20 PRESS AND NEWS Agencies

The Ethiopian press Agency, a Government owned and run agency publishes and circulates two daily and two weekly News papers in different languages namely; Addis zemne and the Ethiopian Herald,Amharic and English News Papers respectively, and Beresa and AlAlem in Oromigna and Arabic in their order are weekly ones. The Ethiopia News Agency is the principal News Agency with its 33 branch offices in all over the country and always receives and disseminates News from and to its clients abroad and in the country. However, there is another party affiliated News Agency Walta Information Center, which is now expanding to many parts of Ethiopia.

Since 1992 a number of private (independent) press Agencies have become operational. During the years between 1992/93 and 1996/97 about 381 licenses were issued and only 314 started operations. But in 1994/95 and 1995/96 there were only 13 and 17 press agents for the respective years. Again in 1996/97 their number rose to 113.

CBI 21: Ministry of Water Resources Networks

Ministry of Water Resources has now established a Water Resources

Information and Metadata base Center. A metadata base (information about data set) has been created and is currently disseminating data and information using UNECA's website

geoinfo.uneca.org to all potential users of the Ministry's Data Center. The Ministry also uses local area network and wide area network. Through LAN and WAN networks, Ministry avails users with aerial photographs, digital multimedia data, documents, articles and tabular data that are related to water resources. Ministry therefore, disseminates data and information using these available networks and at the same time acquires required data and information from.

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