

PART III Backbone

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Volume III Feasibility Study

Part III Backbone

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Technical Specifications for Addis Ababa – Nazareth
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1. OVERVIEW

1.1 Background of the Feasibility Study

The Federal Democratic Republic of Ethiopia is located in the northeastern part of the African continent, in the area commonly referred to as the Horn of Africa.

In the past the country was facing Saudi Arabia across the Red Sea, but with the independence of the State of Eritrea, the country became landlocked. The country borders the Republic of Djibouti to the east, the Republic of the Sudan to the west, Kenya to the south, the Somali Democratic Republic to the southeast, and Eritrea along the coast of the Red Sea. The gross area of the country is 1.12 million square kilometers, which is roughly three times size of Japan. It is an independent nation with population of 65 million people. Approximately two-third of total area lies on the 1,500-3,000m high African plateau. Therefore, the country has a difference of climate due to altitude and geographical conditions, so the country is broadly classified into cold, mild, and hot districts.

The capital Addis Ababa is located at 2,400m above sea level with an average yearly temperature of 10-26°C in the middle of cold and mild district, and has rainy seasons twice a year.

In May 1991, the socialist regime was overthrown and interim government was established. The interim government then enacted a new constitution and held a general election, and then formally transferred its power to the new government in August 1995. The Ethiopian government has established and is currently executing the Second 5-year national economic development plan (2000/1-2004/5) that was revised based on the review of the national development plan (1995/6-1999/00).

In the telecommunications field, total number of subscribers is approximately 320 thousand as of the first quarter of 2002. Further, the telephone penetration rate is 0.5 units per 100 persons, while this is much lower than that of entire Africa (4.87 units per 100 persons). In addition, the country has approximately 160 thousand waiting applicants. Though nationwide telecommunications network has been constructed, the transmission facilities are quite obsolete, including decrepit analog transmission equipment. Furthermore, the switching system partially consists of the old type exchanges including the manual attendant boards, and the parts of the cable and duct facilities (ducts, manholes, etc.) are also decrepit. Subscriber line faults are occurring frequently. Thus the Ethiopian telecommunications facilities are still far behind in both quality and quantity.

1.2 Purpose of the Investigation

The purpose of the investigation is to conduct a feasibility study (F/S) for the backbone transmission link between Addis Ababa and Nazareth selected according to the selection criteria set in the master plan (M/P), and to conduct technical transfer to the counterpart (CP) through the Feasibility Study processes.

1.3 Project Area of the Feasibility Study (F/S)

The construction of a backbone transmission link between Addis Ababa and Nazareth is the most effective measures for the ETC to ease traffic congestion in East, Southeast and South regions. Therefore, this area is selected as a target project of F/S according to the selection standard and the analysis results, stipulated in the M/P and the following policy.

(1) Select the Project According to the Priority Specified in the M/P.

Construct a backbone transmission link that will ease the traffic congestion in segments where transmission capacity is tight or traffic is concentrated, according to the traffic analysis of the M/P.

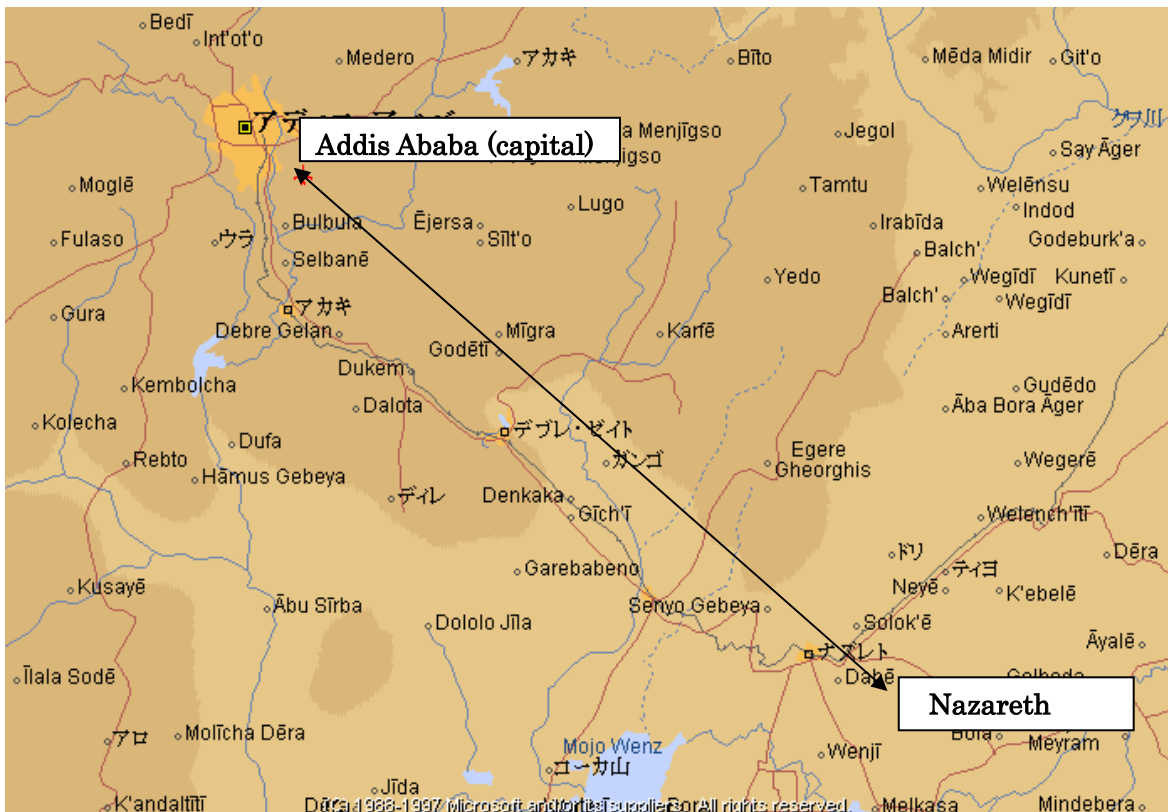
(2) Select the Project Area That Will Bring Great Economical Effect and Benefits.

The F/S group verified the effect that will be produced by the construction of a new backbone in the area selected according to the above policy.

As a result, Addis Ababa – Nazareth area was selected.

Figure 1.1 shows the F/S project area (Addis Ababa – Nazareth).

Figure 1.1 F/S Project Area (Addis Ababa – Nazareth)



1.4 Investigation Policy and Schedule

The F/S group has formulated the basic policy shown below for the construction of the backbone in the F/S project area, while examining the following plans.

1.4.1 Examined Plans

- (1) The Second National Economic Development Plan (2000/1 – 2004/5)
- (2) Public Sector Investment Plan (2000/1 – 2004/5)
- (3) Telecommunications Development Master Plan (2003/4 – 2020/21)
- (4) The ETC eighth 5-year Plan (2000/1 – 2004/5)
- (5) Current state of existing telecommunications networks

The basic policy calls for the construction of transmission networks that provide both qualitative and quantitative improvements for the project area, along with the verification of the compliance of optical fiber transmission networks as a trial of socio-economic revitalization and improvement of telecommunications services in the neighboring areas. This policy was established in consideration of applying it for the future development of backbone transmission networks in other areas. The basic policy is described below.

1.4.2 Basic Policy of Investigation Plan

Target: Addis Ababa – Nazareth backbone transmission link

Construct an optical fiber backbone transmission link in order to ease the traffic congestion at the Mt. Furi microwave repeater station. Main items proposed in this report are as follows:

- 1) Establishment of backbone transmission link construction plan for the area investigated.
- 2) Establishment of implementation plan for the construction of a backbone transmission link.
- 3) Estimate of costs and expenses for the implementation plan.
- 4) Feasibility study based on financial and economic analyses for the implementation plan.

1.4.3 Investigation Schedule and Survey Items

- 1) Survey period: August 15, 2002- August 22, 2002
- 2) Survey items
 - ① AA-Nazareth optical fiber backbone link route survey
 - ② Transmission facilities and building condition check at A.A. IR/ITE Telecommunications Center
 - ③ Transmission facilities and building condition check at A.A. Filwoha Telecommunications Center
 - ④ Transmission facilities and building condition check at A.A. Nefas Silk Telecommunications Center
 - ⑤ Transmission facilities and building condition check at AKAKI Station
 - ⑥ Transmission facilities and building condition check at Debre Zeit Station
 - ⑦ Transmission facilities and Building condition check at ADAMA West M/W Rep.

Station

- ⑧ Transmission facilities and building condition check at Nazareth P.C.

1.5 Organization of the Feasibility Study Team

(1) JICA Feasibility Study Team

1) Feasibility Study Team

Team Leader	: Ryoji Sasaki
Outside plant/Demand Forecast	: Shinichi Shoji
Switching/Traffic Forecast	: Takashi Yamamoto
Outside plant	: Tetsuya Sakamoto
Transmission System / PCO	: Hiroshi Fujii
Radio System/ PCO	: Takashi Matsuoka
Operation and Maintenance	: Kiyofumi Yamamura
Economic/ Financial Analysis	: Tomoyuki Kuroda
Organization and Human Resource	: Naoki Hara

2) JICA Advisory Committee

Chairman	: Takashi Miyashita
Member	: Takashi Hirose

(2) ETC Staff Members

Names and titles of Staff members of the ETC, who have provided us with valuable opinions and cooperation for the local investigation and collection of necessary materials/documents within and outside the ETC, throughout the duration of the investigative process, are listed below:

1) ETC Headquarters

Mr. Tesfaye (Outside plant)

Mr. Teklemariam Laeke (Transmission system)

2. SOCIO-ECONOMIC STATUS OF ETHIOPIA

The economy of Ethiopia and individual incomes of its people is growing under the influence of agricultural harvest yield. In the past eight years, however, the gross domestic product (GDP) has been sluggish, with its growth being lower than that of the population. As a principal cause of this phenomenon, the influence of the drought in 1997 can be blamed.

2.1 Gross Domestic Product (GDP)

GDP real growth rate has averaged 5.24% during 1993/94 – 1999/2000 according to Ethiopian and IMF data. However, these aggregate figures reflect favourable climate and harvests rather than the discernible, unambiguous impact of policy changes. Table 2.1 indicated that Growth of 10.6% in 1995/96 has been undermined since 1997/98 by drought and war.

Table 2.1 Gross Domestic Product of Ethiopia for Individual Production Sectors

Unit: Birr million

Sector	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/2000
1. Agriculture, Fishing	6,078.0	6,284.0	7,206.2	7,453.9	6,648.9	6,904.2	7,052.8
2. Industry	1,307.0	1,412.5	1,488.9	1,593.8	1,630.9	1,815.7	1,870.9
3. Distributive Service	1,650.9	1,757.3	1,914.7	2,062.1	2,177.9	2,253.9	2,423.1
4. Other Service	2,963.3	3,190.5	3,377.3	3,603.8	4,084.9	4,487.1	4,955.0
5. GDP	11,999.2	12,644.4	13,987.1	14,713.6	14,542.6	15,460.9	16,301.8
6. Growth Rate	1.70%	5.37%	10.60%	5.19%	-1.16%	6.31%	5.43%

Note: 1980/1981 Factor cost

Source: MoFED (MEDaC)

2.2 Population

According to the national census report of Ethiopia, the overall population of the country in 2001 was approximately 65 million, with the average annual growth between 1995 and 2000 being 3.02%.

The average number of people in a household for the year 1994 was 4.8.

Further, 85% of the overall population lives in the rural areas, while about half of the remaining 15% live in Addis Ababa and larger regional cities.

Population distribution obtained as a result of the national census is shown in Table 2.2 “Population Distribution.”

Table 2.2 Population and Land Area of Individual Provinces (investigated in 2001)

Province	Population	Urban Pop.	Rural Pop.	Land Area (Sq.km)
Tigray	3,803,000	638,904	3,164,096	50,078.64
Affar	1,246,000	100,926	1,145,074	n.a.
Amhara	16,773,000	1,727,619	15,045,381	159,173.66
Oromiya	23,058,000	2,720,844	20,337,156	353,006.81
Somali	3,708,000	561,391	3,146,609	n.a.
Benishangul	552,000	48,576	503,424	49,289.46
S.N.N.P..	12,916,000	994,532	11,921,468	112,343.19
Gambela	217,000	36,890	180,110	25,802.01
Addis Ababa	2,574,000	2,574,000	0	530.14
Dire Dawa	331,000	238,320	92,680	1,213.20
Harar	166,000	100,596	65,404	311.25
Total	65,344,000	9,742,598	55,601,402	1,098,000.00

Source: Central Statistical Authority

Note: All localities with population less than 1,000 persons should be considered as rural.

2.3 Status of Project Site

(1) Natural Conditions

1) Climate

The project area for the Addis Ababa–Nazareth backbone transmission link is located along the trunk road with a vertical drop of 760m and a length of 98km, from the capital Addis Ababa (about 2,400m above sea level, to Nazareth city, about 1,640m above sea level). The area is comparatively blessed with natural conditions with mild climate and yearly precipitation of approximately 1,200mm.

2) Ground conditions

This project area has a topography with a lake transformed from the volcanic crater, as indicated by the sightseeing area Debre Zeit (including Lake Hora) and the surrounding lakes. The land of this area is, therefore, covered with the soil of volcanic rocks. As viewed from the trunk road, the ground surface of this area is covered with grasses. However, as going near Nazareth city, the landscape changes to a great grabbed zone. Especially, the valley (240m vertical drop) from the Adama West microwave repeater station to Nazareth city exhibits the reddish-brown rock surfaces.

3) Aspect of the area

- Addis Ababa city and its suburb

At the center of Addis Ababa, roadways and sidewalks separated by edge stones are both paved. There are low-rise and medium-rise buildings (5 to 20 floors) accommodating governmental offices, business offices, banks, and shops, along the trunk road. As moving from the center to the suburb, shopping centers and private

shops of low-rise buildings (1 to 4 floors) are seen. Especially, the private shops along the trunk road are almost one-story houses.

Telecommunication cables are laid by the duct cabling system (6 threads) or directly-buried cabling system into the buildings in the center of the city, while as moving to the suburb, direct-buried cable system is mainly employed. However, according to the sampling investigation result of the city ducts, it was proved that the local telephone cables without any idle space occupy most of cable ducts. The current condition is shown in following pictures.



Photo 1: Duct Survey in Front of AA- Filwoha Telecommunications



Center

**Photo 2 : Duct Condition of AA- Filwoha Telecommunications Center
Intermediate area between Addis Ababa and Nazareth**

Both roadway and shoulders of the trunk road between Addis Ababa and Nazareth are fully paved by the financial aids between two countries. There are Akaki city, Dukem city, Debre Zeit city, and Mojo city along this trunk road. Cables are laid in the duct system, or direct-buried cabling system or aerial cabling system only in the central zone of each city. Transmission links between the cities along the trunk road and to Addis Ababa or Nazareth are decrepit microwave lines.

- Around Adam West Rep. station

The Adam West Rep. station is a microwave repeater station of an existing microwave transmission link, which is located on a small hill along the side road, 2km away from the paved trunk road. The 2km-side road is unpaved.

Telephone poles, which seem to have been used before, are installed from the trunk road to the top of the hill (140m vertical drop) toward the Adam West Rep. station. This route along the side road to the repeater station can be used when laying aerial optical cables. Available aerial cable route is shown in next picture.

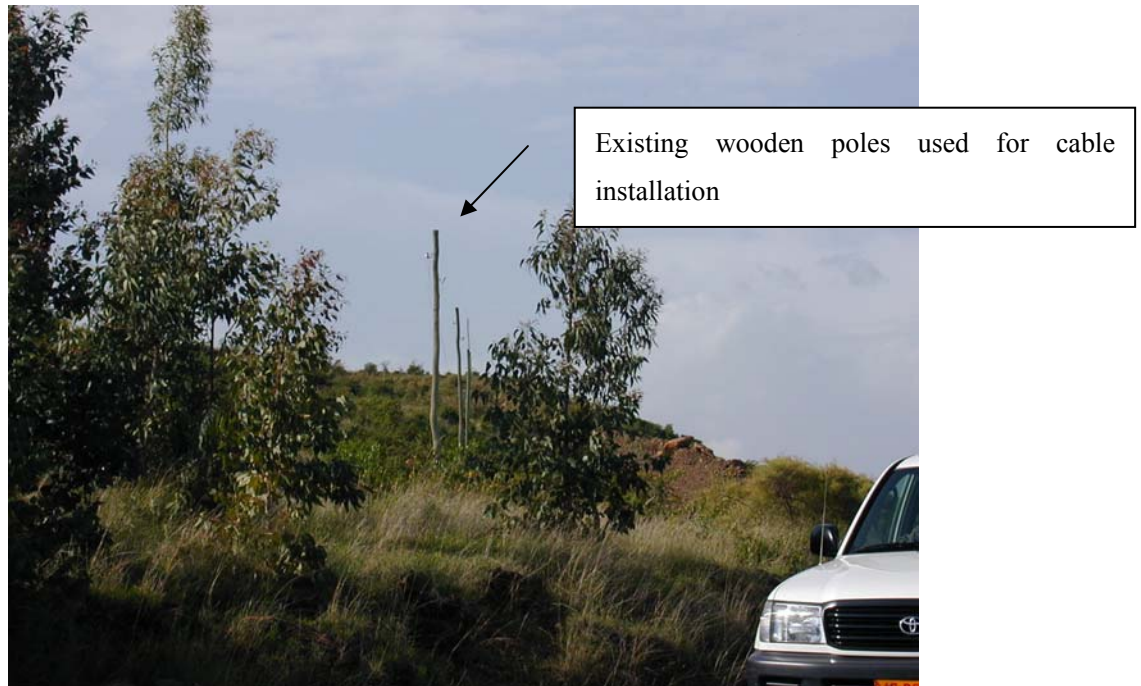


Photo 3: Available Aerial Cable Route to Adam West Rep. Station

- Nazareth city and its suburb

Both roadways and sidewalks separated by edge stones are almost paved at the center of Nazareth city. There are low-rise buildings (1 to 4 floors) accommodating governmental offices, business offices, banks, and shops along the trunk road. As moving from the center to the suburb, many one-story houses are seen along the trunk road.

Telecommunications cables are laid by the duct cabling system or direct-buried cabling system in the central area (within a radius of 2km). Judging from the state of backlog city subscribers, the cable capacity is possibly full, so any space of cable ducts cannot be prospected as in the case of Addis Ababa.

4) Traffic volume

Since this project area is located along the trunk road between Addis Ababa and Nazareth, the traffic volume is high during daytime and special attention is needed because vehicles run at high speeds (approx. 80km/hour). Construction will be carried out without any difficulties, but it is necessary to pay consideration to running vehicles and nearby people with when carrying materials and surplus dug soil or parking construction vehicles.

The current road condition is shown in following picture.



**Photo 4 : The Trunk Road Between Addis Ababa- Nazareth
(Cruising speed was 80km)**

(2) Social Infrastructure Improvement Status

1) Transportation and traffic

Ethiopian transportation and traffic infrastructure is quite poor when the land scale of Ethiopia is considered. Even at present, most of the nation's land (agrarian community in particular) is still isolated from traffic and communications.

a) Marine transportation

Ports and harbors that Ethiopia used were Assab Port and Massawa Port in Eritrea and Djibouti Port in the Republic of Djibouti. Assab and Addis Ababa are connected with the 860km paved road. The volume of distribution of goods using Assab Port accounts for about 80% of the total trade volume of Ethiopia. However, Ethiopia lost Assab Port and Massawa Port due to the independence of Eritrea. For the reason, materials and equipment used in this project will be transported by tracks via Djibouti Port.

b) Railroad

A railroad exists between Addis Ababa and Djibouti. Approximately 60% of the Ethiopian trade volume were handled by the railroad in the past, but at present, the volume of railroad transportation is decreasing year by year due to poor maintenance of the railroad facilities.

c) Land transportation

90% of the domestic transportation volume in Ethiopia relies on roads for both passengers and cargoes. Though poor maintenance and management of roads due to the temporary shortage of fund caused by the civil war deteriorated road networks, financial aids from international organizations and between two countries have considerably developed and improved the major roads. The Addis Ababa - Nazareth area trunk road has also been improved by the financial aids between two countries.

d) Air transportation

Because of the underdeveloped domestic land transportation, both international and domestic air transportations are important means of transportation. Of the total passenger mileage, the international transportation accounts for 97%, and the rest is domestic transportation. Regarding cargo mileage, however, the international transportation accounts for 3%, and domestic transportation accounts for less than 1%. National Ethiopian Airlines is a competitive airline company in Africa and is an important source of acquiring foreign money.

2) Situation of electric power

In Ethiopia, the national Power Corporation “Ethiopian Electric Power Corporation (EEPCO) takes charge of electric power supply. While towns and cities are supplied with electric power, most of the rural districts are not. At present, the EEPCO is steadily proceeding with the development plan for backbone transmission links. Accordingly, non-powered villages will be eliminated step by step. The standard power voltage of Ethiopia is 220V AC.

3) City water and gas

80% of population including the persons using wells is supplied with safe water in towns and cities, while only 6% in rural districts. Accordingly, 17% of total nations are supplied with safe water. Since service water supply is available with water tanks in the local towns and cities, there is no problem for the construction work. On the contrary, utility gas has not come into wide use, and ordinary households use firewood and charcoal for fuel. Even along the trunk road in the project area, sale of charcoals bulked on the roadside is seen.

(3) Impacts on the Environments

1) Protection of forests

In Ethiopia, environmental degradation due to forest destruction, excessive grazing, and cultivation on sloping ground has become a serious problems. Climate and geographical features of Ethiopia are easily subject to the environment. This as well

as droughts and harmful insects have caused surface soil slippage and deforestation due to collection of firewood for fuel. (about 80% of household fuels) At present, however, the environmental protection research and development program for forestation is being promoted with international technical cooperation, focusing on reduction of deforestation and protection of the nature.

To avoid adverse effects on environmental destruction and changes in ecosystem as much as possible, this project decided to lay optical fiber cables on concrete poles without using wooden poles.

2) Construction materials and surplus dug soil

Since the project area has already become an urban area, sites to be excavated are roads in principle. The suburban area has adopted aerial cabling system that suppresses excavation work, and is intending to use a method to minimize the surplus soil discharge.

Because the construction in this area is small-scale engineering work, the volume of gravel and sand for construction, and surplus dug soil will not have much effect on environmental contamination and the environment of nearby inhabitants.